普通高等教育“十五”规划教材
PUTONG GAODENG JIAOYU SHIWU GUIHUA JIAOCAI

# 机械工程专业英语

杨正 主编　张昌耀 路由 副主编

中国电力出版社
http://jc.cepp.com.cn

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## 内 容 提 要


本书为普通高等教育“十五”规划教材。全书共分12单元，每个单元包含三部分内容，第一部分为课文，第二部分为阅读理解，第三部分为翻译技巧。本书主要介绍了汽车、缆车、卡车、推土机、液压机械的结构和特征，同时还包括工业设计的内容。书中涵盖机械工程各主要学科的内容，选择最先进实用的机械工程设备为阅读材料，并在扩大和掌握专业词汇，熟悉专业英语的写作及表达方式的基础上，介绍了国内外先进的专业化施工设备、机械运行设备等内容。

本书主要作为机械工程专业的教材，也可作为函授和自考辅导用书或供相关专业人员参考。



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# 序

由中国电力教育协会组织的普通高等教育“十五”规划教材，经过各方的努力与协作，现在陆续出版发行了。这些教材既是有关高等院校教学改革成果的体现，也是各位专家教授丰富的教学经验的结晶。这些教材的出版，必将对培养和造就我国21世纪高级专门人才发挥十分重要的作用。

自1978年以来，原水利电力部、原能源部、原电力工业部相继规划了一至四轮统编教材，共计出版了各类教材1000余种。这些教材在改革开放以来的社会主义经济建设中，为深化教育教学改革，全面推进素质教育，为培养一批批优秀的专业人才，提供了重要保证。原全国高等学校电力、热动、水电类专业教学指导委员会在此间的教材建设工作中，发挥了极其重要的历史性作用。

特别需要指出的是，“九五”期间出版的很多高等学校教材，经过多年的教学实践检验，现在已经成为广泛使用的精品教材。这批教材的出版，对于高等教育教材建设起到了很好的指导和推动作用。同时，我们也应该看到，现用教材中有不少内容陈旧，未能反映当前科技发展的最新成果，不能满足按新的专业目录修订的教学计划和课程设置的需要，而且一些课程的教材可供选择的品种太少。此外，随着电力体制的改革和电力工业的快速发展，对于高级专门人才的需求格局和素质要求也发生了很大变化，新的学科门类也在不断发展。所有这些，都要求我们的高等教育教材建设必须与时俱进，开拓创新，要求我们尽快出版一批内容新、体系新、方法新、手段新，在内容质量上、出版质量上有突破的高水平教材。

根据教育部《关于“十五”期间普通高等教育教材建设与改革的意见》的精神，“十五”期间普通高等教育教材建设的工作任务就是通过多层次的教材建设，逐步建立起多学科、多类型、多层次、多品种系列配套的教材体系。为此，中国电力教育协会在充分发挥各有关高校学科优势的基础上，组织制订了反映电力行业特点的“十五”教材规划。“十五”规划教材包括修订教材和新编教材。对于原能源部、电力工业部组织原全国高等学校电力、热动、水电类专业教学指导委员会编写出版的第一至四轮全国统编教材、“九五”国家重点教材和其他已出版的各类教材，根据教学需要进行修订。对于新编教材，要求体现电力及相关行业发展对人才素质的要求，反映相关专业科技发展的最新成就和教学内容、课程体系的改革成果，在教材内容和编写体系的选择上不仅要有本学科（专业）的特色，而且注意体现素质教育和创新能力与实践能力的培养，为学生知识、能力、素质协调发展创造条件。考虑到各校办学特色和培养目标不同，同一门课程可以有多本教材供选择使用。上述教材经中国电力教育协会电气工程学科教学委员会、能源动力工程学科教学委员会、电力经济管理学科教学委员会的有关专家评审，推荐作为高等学校教材。

在“十五”教材规划的组织实施过程中，得到了教育部、国家经贸委、国家电力公司、中国电力企业联合会、有关高等院校和广大教师的大力支持，在此一并表示衷心的感谢。

教材建设是一项长期而艰巨的任务，不可能一蹴而就，需要不断完善。因此，在教材的使用过程中，请大家随时提出宝贵的意见和建议，以便今后修订或增补。（联系方式：100761 北京市宣武区白广路二条1号综合楼9层 中国电力教育协会教材建设办公室 010-63416222）

**中国电力教育协会**

二〇〇二年八月

# 前　言

随着我国与国外的交流日益广泛，对于大学生学习外语的要求越来越高。专业英语阅读及其翻译是外语学习中的一个重要内容。

我国理工科学生在校期间都接受过系统的普通英语教育，但普通英语与其所学的专业课程却鲜有沟通，因此，专业英语正是为弥补普通英语的不足而开设的。本教材是在学生学完大学公共英语课程的基础上，结合机械工程类学生所学专业而编写的。其目的在于加强学生对专业书籍及论文的阅读、翻译及写作能力，进一步提高学生实际应用英语的水平。

本教材的基本内容是通过精选与本专业相关的代表性文章，并尽可能地选择最先进实用的机械工程设备的产品介绍或使用指南作为阅读材料，同时考虑到工业设计对机械类学科的影响日益增大，因此在教材中也适当增加了部分工业设计的相关内容，使学生在学习专业英语的同时，也能了解到本学科最新的发展动态。通过对课文的阅读及练习，扩大学生的专业词汇量，并熟悉掌握专业英语的语法特点及语言结构特点，逐步掌握专业英语的翻译技巧及写作技巧。通过对本教材的学习，要求学生能阅读和翻译一般性的专业文章及书籍，并能写作一般性的专业短文。

科技英语的翻译也是学习专业英语的主要目的之一。就本课程而言，作者希望通过翻译技巧的学习，来达到将英语的科技文献翻译成通顺的、符合表达习惯的汉语的目的。翻译技巧有许多，本书只是根据课文的内容，对常用的技巧分别加以介绍，并附有练习，给学生打下一定的基础，以便他们在将来的翻译实践中能“有章可循”，并通过实践来丰富自己的翻译经验，提高翻译能力。

本教材计划学时为48～54学时，教师可根据实际情况对内容进行取舍。

虽然作者长期从事机械工程专业英语的教学，也积累了一些教学经验，但毕竟学无止境，对取材的内容及难易程度的把握也有待斟酌，书中难免有缺点、错误，恳请读者指正。

作者

2003年10月于武汉大学珞珈山

# 目录

# Unit One

## Part One  Text
## General Considerations

The word machine has been given a wide variety of definitions, but for the purpose of this article it is a device, having a unique purpose, that augments or replaces human or animal effort for the accomplishment of physical tasks. Tools may be regarded as the simplest class of machines. The operation of a machine may involve the transformation of chemical, thermal, electrical, or nuclear energy into mechanical energy, or vice versa, or its function may simply be to modify and transmit forces and motions. All machines have an input, an output, and a transforming or modifying and transmitting device.

Machines that receive their input energy from a natural source, such as air currents, moving water, coal, petroleum, or uranium, and transform it into mechanical energy are known as prime movers. Windmills, waterwheels, turbines, steam engines, and internal-combustion engines are prime movers. In these machines the inputs vary; the outputs are usually rotating shafts capable of being used as inputs to other machines, such as electric generators, hydraulic pumps, or air compressors. All three of the latter devices may be classified as generators; their outputs of electrical, hydraulic, and pneumatic energy can be used as inputs to electric, hydraulic, or air motors. These motors can be used to drive machines with a variety of outputs, such as materials processing, packaging, or conveying machinery. All machines that are neither prime movers and generators, nor motors may be classified as operators. This category also includes manually operated instruments of all kinds, such as calculating machines and typewriters.

If the operator is a pump driven by an electric motor, the flow of energy from the prime mover at the power plant through the generator and motor to the operator is as shown in Fig.1.

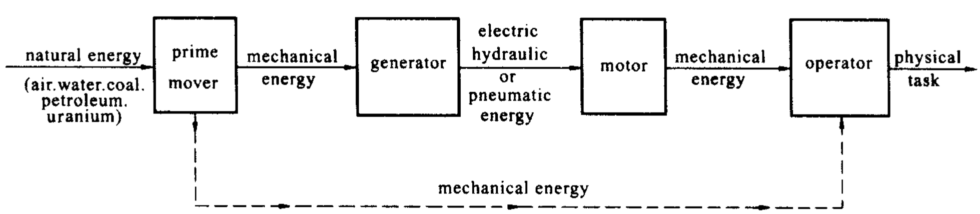


Fig. 1  Flow of energy in machines

The operator can also be driven directly by a small, direct-connected prime mover, such as a gasoline engine, as shown by the dotted line in Figure 1; for most power-driven operators, however, the flow of energy from the prime mover follows the solid lines.

In some cases, machines in all categories are combined in one unit. In a diesel-electric locomotive, for example, the diesel engine is the prime mover, which drives the electric generator, which, in turn, supplies electric current to the motors that drive the wheels.

The following are some examples supplied by an automobile.

In an automobile, the basic problem is harnessing the explosive effect of gasoline to provide power to rotate the rear wheels. The explosion of the gasoline in the cylinders pushes the pistons down, and the transmission and modification of this translator (linear) motion to rotary motion of the crankshaft is effected by the connecting rods that join each piston to the cranks that are part of the crankshaft. The piston, cylinder, crank, and connecting rod combination is known as slider-crank mechanism; it is a commonly used method of converting translation to rotation (as in an engine) or rotation to translation (as in a pump).

To admit the gasoline-air mixture to the cylinders and exhaust the burned gases, valves are used; these are opened and closed by the wedging action of cams (projections) on a rotating camshaft that is driven from the crankshaft by gears or a chain.

In a four-stroke-cycle engine with eight cylinders, the crankshaft receives an impulse at some point along its length every quarter revolution. To smooth out the effect of these intermittent impulses on the speed of the crankshaft, a flywheel is used. This is a heavy wheel, attached to the crankshaft, which by its inertia opposes and moderates any speed fluctuations.

Since the torque (turning force) that it delivers depends on its speed, an internal-combustion engine cannot be started under load. To enable an automobile engine to be started in an unloaded state and then connected to the wheels without stalling, a clutch and a transmission are necessary. The former makes and breaks the connection between the crankshaft and the transmission, while the latter changes, in finite steps the ratio between the input and output speeds and torques of the transmission. In low gear, the output speed is low and the output torque higher than the engine torque, so that the car can be started moving; in high gear, the car is moving at a substantial speed and the torques and speeds are equal.

The axles to which the wheels are attached are contained in the rear axle housing, which is clamped to the rear springs, and are driven from the transmission by the drive shaft. As the car moves and the springs flex in response to bumps in the road, the housing moves relative to the transmission; to permit this movement without interfering with the transmission of torque, a universal joint is attached to each end of the drive shaft.

The drive shaft is perpendicular to the rear axles. The right-angled connection is usually made with bevel gears having a ratio such that the axles rotate at from one-third to one-fourth the speed of the drive shaft. The rear axle housing also holds the differential gears that permit both rear wheels to be driven from the same source and to rotate at different speeds when turning a corner.

Like all moving mechanical devices, automobiles cannot escape from the effects of friction. In the engine, transmission, rear axle housing, and all bearings, friction is undesirable, since it increases the power required from the engine; lubrication reduces but does not eliminate this friction. On the other hand, friction between the tires and the road and in the brake shoes makes traction and braking possible. The belts that drive the fan, generator, and other accessories are friction-dependent devices. Friction is also useful in the operation of the clutch. Some of the devices cited above, and others that are described below, are found in machines of all categories, assembled in a multitude of ways to perform all kinds of physical tasks. Because of this diversity of function and the lack of common characteristics, this article will not be concerned with specific operators. Neither will it deal with the overall performance of prime movers, nor with the operation of hydraulic, pneumatic, or electrical devices. It will consider only the operation and structure of the basic mechanical devices that are the constituent parts of machines. The function of most of these devices is to transmit and modify force and motion. Other devices, such as springs, flywheels, shafts, and fasteners, perform supplementary functions.

For the purposes of this article a machine may be further defined as a device consisting of two or more resistant, relatively constrained parts that may serve to transmit and modify force and motion in order to do work. The requirement that the parts of a machine be resistant implies that they be capable of carrying imposed loads without failure or loss of function. Although most machine parts are solid metallic bodies of suitable proportions, nonmetallic materials, springs, fluid pressure organs, and tension organs such as belts are also employed.

The most distinctive characteristic of a machine is that the parts are interconnected and guided in such a way that their motions relative to one another are constrained. Relative to the block, for example, the piston of a reciprocating engine is constrained by the cylinder to move on a straight path; points on the crankshaft are constrained by the main bearings to move on circular paths; no other forms of relative motion are possible.

On some machines the parts are only partially constrained. If the parts are interconnected by springs or friction members, the paths of the parts relative to one another may be fixed, but the motions of the parts may be affected by the stiffness of the springs, friction, and the masses of the parts.

If all the parts of a machine are comparatively rigid members whose deflections under load are negligible, then the constraint may be considered complete and the relative motions of the parts can be studied without considering the forces that produce them. For a specified rotational speed of the crankshaft of a reciprocating engine, for example, the corresponding speeds of points on the connecting rod and the piston can be calculated. The determination of the displacements, velocities, and accelerations of the parts of a machine for a prescribed input motion is the subject matter of kinematics of machines. Such calculations can be made without considering the forces involved, because the motions are constrained.

According to the definition, both forces and motions are transmitted and modified in a machine. The way in which the parts of a machine are interconnected and guided to produce a required output motion from a given input motion is known as the mechanism of the machine. The piston, connecting rod, and crankshaft in a reciprocating engine constitute a mechanism for changing the rectilinear motion of the piston into the rotary motion of the crankshaft.

Although both forces and motions are involved in the operation of machines, the primary function of a machine may be either the amplification of force or the modification of motion. A lever is essentially a force increaser, while a gearbox is most often used as a speed reducer. The motions and forces in a machine are inseparable, however, and are always in an inverse ratio. The output force on a lever is greater than the input force, but the output motion is less than the input motion. Similarly the output speed of a gear reducer is less than the input speed, but the output torque is greater than the input torque. In the first case a gain in force is accompanied by a loss in motion, while in the second case a loss in motion is accompanied by a gain in torque.

Although the primary function of some machines can be identified, it would be difficult to classify all machines as either force or motion modifiers; some machines belong in both categories. All machines, however, must perform a motion-modifying function, since if the parts of a mechanical device do not move; it is a structure, not a machine. It is customary for machinery designers, when studying the motions of the parts, to speak of the mechanism of a machine.

While all machines have a mechanism, and consequently perform a motion-modifying function, some machines do not have a planned force-modifying purpose; the forces that exist are caused by friction and the inertia of the moving masses and do not appear as a useful output effort. This group would include measuring instruments and clocks.

## Vocabulary

a (wide) variety of　　各种各样的；多种多样的

| | |
|---|---|
| for the purpose of | 对……来说;为了……起见 |
| every quarter revolution | 每转 1/4 圈,是时间状语 |
| by inertia | 靠惯性;借助惯性 |
| under load | 在有负载的情况下;在荷载的作用下 |
| without stalling | 不致(使发动机)减速、停车或灭火 |
| make and break | 接合与分离;接通与切断 |
| in finite steps | 分几级;分几档 |
| in low gear | 在低速档 |
| at a substantial speed | 以高速;高速度地 |
| drive shaft | 主动轴;传动轴 |
| in a multitude of ways | 以许多种方法;以各种方式 |
| a multitude of | 许多的 |
| subject matter | 题材;题目;主题;论题 |
| force increaser | 增力器,即"省力的装置" |
| (be)in an inverse ratio | 成反比 |

## Notes and expressions

1. The word machine has been given a wide variety of definitions, but for the purpose of this article it is a device, having a unique purpose, that augments or replaces human or animal effort for the accomplishment of physical tasks.
   机器一词有各种不同的定义,但就本文而言,机器是指有专一用途的装置,能增强或代替人或动物为完成体力劳动付出的努力。
2. If the operator is a pump driven by an electric motor, the flow of energy from the prime mover at the power plant through the generator and motor to the operator is as shown in Figure 1.
   如果工作机是一台由电动机驱动的泵,则能量流程如图 1 所示,从电厂原动机经发电机和电动机流到工作机。
   在此句中,from、through 和 to 引导的三个短语都是修饰名词 flow,而 at the power plant 修饰 the prime mover。power plant:发电厂。
3. The piston, cylinder, crank and connecting rod combination is known as slider-crank mechanism.
   活塞、汽缸、曲臂和连杆合为一体,称为曲柄—滑块机构。
   piston、cylinder、crank 和 connecting rod 是 combination 的定语,意为这四个部件的组合。

4. …these are opened and closed by the wedging action of cams (projections) on a rotating camshaft that is driven from the crankshaft by gears or a chain.

……阀门的开启和关闭，是由曲轴通过齿轮或链轮来驱动凸轮轴旋转，再通过旋转凸轮轴上的凸缘(凸起部分)的楔入作用来完成。

from the crankshaft 表示驱动凸轮轴的动力来源，by the gears or a chain 表示动力传输的方式，两个词组都是 driven 的状语。

5. This is a heavy wheel, attached to the crankshaft, which by its inertia opposes and moderated any speed fluctuations.

飞轮是一个很重的轮子，与曲轴连接，借助其惯性来抵消并平滑速度的波动。

by its inertia 是状语，前移到所修饰的动词 opposes 和 moderates 之前。

6. The right-angle connection is usually made with bevel gears having a ratio such that the axles rotate at from one-third to one-fourth the speed of the drive shaft.

通常使用一定速比的圆锥齿轮实现直角连接，使得车轴能以驱动轴的 1/3 到 1/4 的速度旋转。

such 修饰前面的 ratio, 其后的 that 引导一个结果状语。a ratio such that…用法和意义与 such a ratio that…一样。

7. The belts that drive the fan, generator, and other accessories are friction-dependent devices.

驱动风扇、发电机和其他辅助设备的传动带都是依赖摩擦工作的装置。

Friction-dependent devices 可理解为 devices that are dependent on friction。

8. The most distinctive characteristic of a machine is that the parts are interconnected and guided in such a way that their motions relative to one another are constrained.

机器最显著的特点是部件间相互连接并定向运动，使得部件之间的相对运动受到制约。

in such a way that 引导结果状语从句，表示“通过如此的方法以致达到某种结果”。

9. If all the parts of a machine are comparatively rigid members whose deflections under load are negligible, then the constraint may be considered complete and the relative motions of the parts can be studied without considering the forces that produce them.

如果机器的所有部件都是相对刚性的构件，且它们在载荷条件下的变形又可忽略不计，则可以被认为受到完全约束。因此，对部件的相对运动进行研究时不必考虑力对其(变形的)影响。

10. For a specified rotational speed of the crankshaft of a reciprocating engine, the corresponding speeds of points on the connecting rod and the piston can be calculated.

对于往复式发动机曲轴的确定的旋转速度，能够计算出连杆和活塞上的点的相应速度。

# Part Two Reading Comprehension

## 1. What is work

People generally consider work to be done when force is applied. However, from a scientific point of view, work is done only if the applied force produces motion. From this point of view, no work is done if a force, no matter how large, is applied to an immovable object.

As we have seen, when we consider a force, we must also take into consideration the direction in which it is applied. So also when we think of work, we must consider the force and the distance that the force moves the body.

You can readily see that if you tried to raise a 100-pound stone two feet, you would have to do more work than if you were to raise it one foot. Work, then, is measured by the product of the force (in pounds) and the distance (in feet) through which motion takes place in the direction of the force. The unit of work, accordingly, is the foot-pound.

To raise the stone one foot would require 100 foot-pounds of work ($100 \times 1 = 100$ foot-pounds). To raise it two feet, you must perform 200 foot-pounds of work ($100 \times 2 = 200$ foot-pounds). By the same token, you would need 200 foot-pounds of work to raise a 200 pounds weight one foot ($200 \times 1 = 200$ foot-pounds).

1. In scientific terms, ________.
   a. work is done when great force is applied to an object
   b. work is done when force is applied to a movable object
   c. work is done when force is applied and motion is produced
   d. work is done when the applied force is large
2. Which of the following example shows no work is done? ________.
   a. A strong man pushes a building
   b. A girl kicks a ball
   c. An old man throws up an apple
   d. A woman lifts up her baby
3. We determine how much work is done ________.
   a. by measuring the distance through which body is moved by the force applied
   b. by measuring the force which is applied to a movable object
   c. by multiplying the force applied and the distance covered
   d. by finding out the direction in which force is applied and an object is moved
4. What amount of work is required to push a 30-pound object ten feet? ________.
   a. 300 foot-pounds of work

b. 30 foot-pounds of work

c. 60 foot-pounds of work

d. 150 foot-pounds of work

5. The word "accordingly" can be replaced by ________.

a. therefore

b. however

c. moreover

d. similarly

**2. Definition and its units of work**

We have learned that forces may be exerted without producing motion. From the point of view of mechanics, no work is done. If, however, forces result in motion, we say that work is done.

Here we find that the term "work" has been given by science a somewhat more limited meaning than that to which we have been accustomed. We ordinarily think of work as exertion of any kind. When man tries to lift a heavy load, he exerts a great deal of force. But from the scientific point of view he does not work unless he actually moves the heavy load. In order to accomplish work, a force must be exerted and must result in movement over a measurable distance. The amount of work done by force acting on an object is equal to the amount of the force multiplied by the distance the object is moved.

Since work involves both force and distance, it is natural for us to expect that the units in which work is measured must express both force and distance. The more commonly used units of work are the gram-centimeter, kilogram-meter in the metric system and the foot-pound in the English system. It is desirable to use large units for the measurement of large quantities and small units for small quantities. Thus we find it convenient to express the weight of a load of coal in tons instead of ounces, and the length of a nail in inches instead of miles.

1. We learn from the passage ________.

a. how work involves both force and distance

b. how work is done when force is applied

c. why there are different systems of the units of work

d. why work is measured in either the foot-pound or the kilometer

2. Which of the following will the author agree with ________ ?

a. ordinary people give a broader meaning to the term "work" than scientists do

b. scientists believe that work is done when the applied force produces vertical motion

c. a science student should know that force necessarily means work

d. scientists and ordinary people think of work in a different way because they refer to different kinds of force

3. It is suggested in the passage that ________ .
   a. no motion may be produced when force is applied
   b. motion is produced when force is applied
   c. motion must result from force
   d. force must result in motion
4. We can conclude from the passage that ________.
   a. we'd better use the foot-pound in English speaking countries
   b. we'd better use the foot-pound only in Britain
   c. we'd better use the meter instead of the foot to measure distance
   d. we'd better use the ton instead of the pound to measure the weight of steel
5. The pronoun "it" in Line 6 of the last paragraph refers to ________.
   a. the weight
   b. a load of coat
   c. coal
   d. the infinitive clause headed by "to express"

**3. Mechanical energy**

We have learned that energy is the capacity, which "makes things move their position or change their form" and how machines use energy by changing weak forces operating through longer distances into strong forces operating through shorter distances.

This energy which machines make use of is known as mechanical energy. Through machinery energy expresses itself in motion, and mechanical energy may be thought of as the energy of motion. Any moving object, whether it is a lever, a pulley, a wheel and axle, possesses the energy of motion, which we call kinetic energy. We call it "kinetic" because the word comes from a Greek word meaning "to move".

Not all mechanical energy, however, is kinetic energy. If you pull up a weight with a pulley and hold it in mid-air, the weight has a kind of mechanical energy even though it is not moving. It has stored energy, which may be released if the weight falls to the ground. Such stored mechanical energy is called potential energy, the work "potential" coming from a Latin word which means "having power".

Potential energy, though not so obvious as kinetic energy, exists in many things. There is potential energy in a clock spring after it has been wound, energy which is slowly released to turn the hands of the clock. There is potential energy in gas, which is rapidly released when the gas burns. Notice that when potential energy is released it is turned into kinetic energy; it