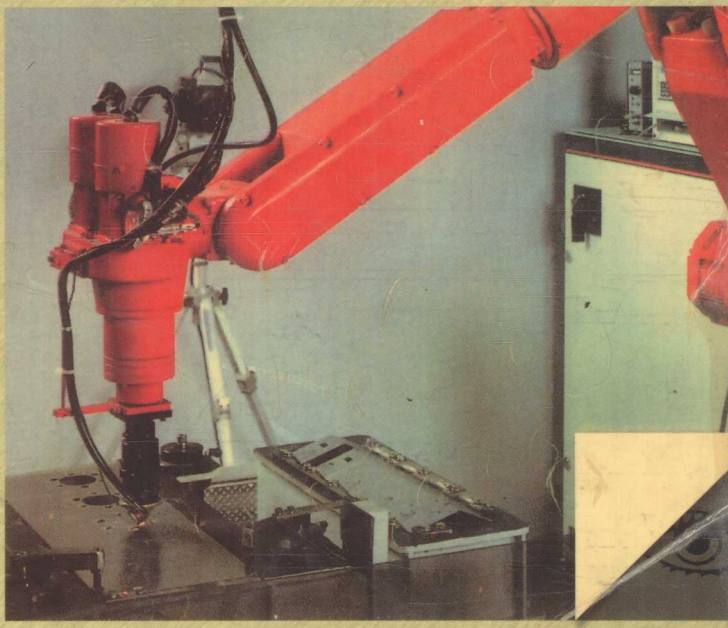
专业英语阅读丛书

机电工程专业英语阅读（修订版）

JIDIAN GONGCHENG ZHUANYE YINGYU YUEDU



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内 容 提 要

本书以培养学生专业英语阅读能力为主要目标。全书共分六个部分，主要内容为机械零件和设计，机床和加工，质量和生产率，制造工程和自动化，现代制造技术及其发展、教育。本书具有较强的实用性和知识延伸性。本书既可作为高等学校机电工程、机械制造等专业学生的教材，也可供从事上述专业的工程技术人员学习、参考之用。

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前　言

国家教委颁布的“大学英语教学大纲”把专业英语阅读列为必修课而纳入英语教学计划，强调通过四年不断线的教学使学生达到顺利阅读专业刊物的目的。根据这个精神，编写了这本《机电工程专业英语阅读》教材，以满足高等院校机电工程和机械制造及其它有关专业学生的专业英语教学的需要和从事上述专业的工程技术人员学习英语的要求。

全书共分六个部分。第一部分为机械零件和设计，第二部分为机床和加工，第三部分为质量和生产率，第四部分为制造工程和自动化，第五部分为现代制造技术及其发展，第六部分为教育。

课文内容比较新颖，文体规范，难度适中。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，力求反映机电工程和机械制造技术的现状和发展趋势，既可提高读者英语阅读水平，又能使读者了解学科前沿。

本书由施平同志主编，参加编写的同志有贾艳敏、邓宗全、张秀华、刘美霞。对书中的不足之处，恳请广大读者批评指正。

编　者

1996 年 1 月

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PART I
Machine Components and Design

1. Couplings, Clutches, Shafts and Springs

A coupling is a device for connecting the ends of adjacent shafts. In machine construction, couplings are used to effect a semipermanent connection between adjacent rotating shafts. The connection is permanent in the sense that it is not meant to be broken during the useful life of the machine, but it can be broken and restored in an emergency or when worn parts are replaced.

There are several types of shaft couplings, their characteristics depend on the purpose for which they are used. If an exceptionally long shaft is required for a line shaft in a manufacturing plant or a propeller shaft on a ship, it is made in sections that are coupled together with rigid couplings. A common type of rigid coupling consists of two mating radial flanges (disks) that are attached by key-driven hubs to the ends of adjacent shaft sections and bolted together through the flanges to form a rigid connection. Alignment of the connected shafts is usually effected by means of a rabbet joint on the face of the flanges.

In connecting shafts belonging to separate devices (such as an electric motor and a gearbox), precise aligning of the shafts is difficult and a flexible coupling is used. This coupling connects the shafts in such a way as to minimize the harmful effects of shaft misalignment. Flexible couplings also permit the shafts to deflect under their separate systems of loads and to move freely (float) in the axial direction without interfering with one another. Flexible couplings can also serve to reduce the intensity of shock loads and vibrations

transmitted from one shaft to another.

The flexibility provided by a coupling may be only spatial or it may be both spatial and resilient (springy); in other words, the coupling may compensate for shaft misalignment but provide no resilience, or it may be resilient and provide also for a small amount of misalignment.

A clutch is a device for quickly and easily connecting or disconnecting a rotatable shaft and a rotating coaxial shaft. Clutches are usually placed between the input shaft to a machine and the output shaft from the driving motor, and provide a convenient means for starting and stopping the machine and permitting the driver motor or engine to be started in an unloaded state.

The rotor (rotating member) in an electric motor has rotational inertia, and a torque is required to bring it up to speed when the motor is started. If the motor shaft is rigidly connected to a load with a large rotational inertia, and the motor is started suddenly by closing a switch, the motor may not have sufficient torque capacity to bring the motor shaft up to speed before the windings in the motor are burned out by the excessive current demands. A clutch between the motor and the load shafts will restrict the starting torque on the motor to that required to accelerate the rotor and parts of the clutch only.

On some machine tools it is convenient to let the driving motor run continuously and to start and stop the machine by operating a clutch. Other machine tools receive their power from belts driven by pulleys on intermediate shafts that are themselves driven by belts from long lineshafts that serve a group of machines.

A shaft is a rotating or stationary member, usually of circular cross section, having mounted upon it such elements as gears, pulleys, flywheels, cranks, and other power-transmission elements. Shafts may be subjected to bending, tension, compression, or torsional loads, acting singly or in combination with one another. When

they are combined, one may expect to find both static and fatigue strength to be important design considerations, since a single shaft may be subjected to static stresses, completely reversed stresses, and repeated stresses, all acting at the same time. The word "shaft" covers numerous variations, such as axles and spindles. An axle is a shaft, either stationary or rotating, not subjected to a torsion load. A short rotating shaft is often callad a spindle.

A spring is a load-sensitive, energy-storing device the chief characteristics of which are an ability to tolerate large deflections without failure and to recover its initial size and shape when loads are removed. Although most springs are mechanical and derive their effectiveness from the flexibility inherent in metallic elements, hydraulic springs and air springs are also obtainable.

Springs are used for a variety of purposes, such as supplying the motive power in clocks and watches, cushioning transport vehicles, measuring weights, restraining machine elements, mitigating the transmission of periodic disturbing forces from unbalanced rotating machines to the supporting structure, and providing shock protection for delicate instruments during shipment.

Words and Expressions

coupling ['kʌpliŋ] *n.* 耦合，联系，配合；匹配，联轴节，连接器
propeller [prə'pelə] *n.* 螺旋桨，推进器
flange [flændʒ] *n.* 凸缘，法兰(盘)；*v.* 装以凸缘，装以法兰(盘)
alignment [ə'lainmənt] *n.* (列成)一直线，直线对准，调准，校直，定位，对中心
rabbet ['ræbit] *n.* 插孔，塞孔，槽(口)，缺口，凹部，榫接
gearbox ['giəbɔks] *n.* 齿轮箱，变速箱
align [ə'lain] *v.* 使列成一直线，直线对准，调准，调直，定位，定中心
flexible ['fleksəbl] *a.* 柔软的，易弯曲的，可塑造的，适应性强的
interfere [intə'fiə] *vi.* 干涉，干扰，妨碍，同…抵触，冲突(with)

resilience [ri'ziliəns] *n.* 弹性，回弹，弹能，回能，弹性变形
clutch [klʌtʃ] *n.* 离合器；*vt.* 抓住，咬合，使离合器接合
torque [tɔ:k] *n.* 转矩，力矩，扭转
cushion ['kuʃən] *n.* 垫子，缓冲器，减振器；*v.* 给…装减振器，缓冲，使…减弱
mitigate ['mitigeit] *vt.* 使缓和，减轻，调节，防止
line shaft 中间轴；主传动轴；天轴
machine tools 机床；工作母机
spindle [spindl] *n.* 主轴
axle ['æksl] *n.* 心轴
semipermanent *a.* 半永久性的
bolt [boult] *n.* 螺栓，螺杆；*vt.* 用螺栓固定[连接]
hub [hʌb] *n.* 中心(部分)，轮毂，衬套，轴套
coaxial [kou'æksiəl] *a.* 同轴的，共轴的，同心的
pulley ['puli] *n.* 滑轮，皮带轮
torsional ['tɔ:ʃənl] *a.* 扭的，扭转的
spatial ['speiʃəl] *a.* 空间的，立体的
hydraulic [hai'drɔ:lik] *a.* 水力的，液压的，液力的
restrain [ris'trein] *vt.* 抑制，约束，限制
delicate ['delikit] *a.* 精密的，精巧的，灵敏的，脆弱的
springy ['spriŋi] *a.* 有弹力的，有弹性的，似弹簧的
in the sense that... 在…意义上
motive power 动力

2. Lubrication

Although one of the main purposes of lubrication is to reduce friction, any substance—liquid, solid, or gaseous—capable of controlling friction and wear between sliding surfaces can be classed as a lubricant.

Varieties of lubrication

Unlubricated sliding. Metals that have been carefully treated to remove all foreign materials seize and weld to one another when slid together. In the absence of such a high degree of cleanliness, adsorbed gases, water vapour, oxides, and contaminants reduce friction and the tendency to seize but usually result in severe wear; this is called "unlubricated" or dry sliding.

Fluid-film lubrication. Interposing a fluid film that completely separates the sliding surfaces results in fluid-film lubrication. The fluid may be introduced intentionally as the oil in the main bearings of an automobile, or unintentionally, as in the case of water between a smooth rubber tire and a wet pavement. Although the fluid is usually a liquid such as oil, water, and a wide range of other materials, it may also be a gas. The gas most commonly employed is air.

To keep the parts separated, it is necessary that the pressure within the lubricating film balance the load on the sliding surfaces. If the lubricating film's pressure is supplied by an external source, the system is said to be lubricated hydrostatically. If the pressure between the surfaces is generated as a result of the shape and motion of the surfaces themselves, however, the system is hydrodynamically lubricated. This second type of lubrication depends upon the viscous properties of the lubricant.

Boundary lubrication. A condition that lies between unlubri-

cated sliding and fluid-film lubrication is referred to as boundary lubrication, also defined as that condition of lubrication in which the friction between surfaces is determined by the properties of the surfaces and properties of the lubricant other than viscosity. Boundary lubrication encompasses a significant portion of lubrication phenomena and commonly occurs during the starting and stopping of machines.

Solid lubrication. Solids such as graphite and molybdenum disulfide are widely used when normal lubricants do not possess sufficient resistance to load or temperature extremes. But lubricants need not take only such familiar forms as fats, powders, and gases; even some metals commonly serve as sliding surfaces in some sophisticated machines.

Functions of lubricants

Although a lubricant primarily controls friction and wear, it can and ordinarily does perform numerous other functions, which vary with the application and usually are interrelated.

Friction control. The amount and character of the lubricant made available to sliding surfaces have a profound effect upon the friction that is encountered. For example, disregarding such related factors as heat and wear but considering friction alone between two oil-film lubricated surfaces, the friction can be 200 times less than that between the same surfaces with no lubricant. Under fluid-film conditions, friction is directly proportional to the viscosity of the fluid. Some lubricants, such as petroleum derivatives, are available in a great range of viscosities and thus can satisfy a broad spectrum of functional requirements. Under boundary lubrication conditions, the effect of viscosity on friction becomes less significant than the chemical nature of the lubricant.

Wear control. Wear occurs on lubricated surfaces by abrasion, corrosion, and solid-to-solid contact. Proper lubricants will help

combat each type. They reduce abrasive and solid-to-solid contact wear by providing a film that increases the distance between the sliding surfaces, thereby lessening the damage by abrasive contaminants and surface asperities.

Temperature control. Lubricants assist in controlling temperature by reducing friction and carrying off the heat that is generated. Effectiveness depends upon the amount of lubricant supplied, the ambient temperature, and the provision for external cooling. To a lesser extent, the type of lubricant also affects surface temperature.

Corrosion control. The role of a lubricant in controlling corrosion of the surfaces themselves is twofold. When machinery is idle, the lubricant acts as a preservative. When machinery is in use, the lubricant controls corrosion by coating lubricated parts with a protective film that may contain additives to neutralize corrosive materials. The ability of a lubricant to control corrosion is directly related to the thickness of the lubricant film remaining on the metal surfaces and the chemical composition of the lubricant.

Other functions

Lubricants are frequently used for purposes other than the reduction of friction. Some of these applications are described below.

Power transmission. Lubricants are widely employed as hydraulic fluids in fluid transmission devices.

Insulation. In specialized applications such as transformers and switchgear, lubricants with high dielectric constants act as electrical insulators. For maximum insulating properties, a lubricant must be kept free of contaminants and water.

Shock dampening. Lubricants act as shock-dampening fluids in energy-transferring devices such as shock absorbers and around machine parts such as gears that are subjected to high intermittent loads.

Sealing. Lubricating grease frequently performs the special function of forming a seal to retain lubricants or to exclude contaminants.

Words and Expressions

lubrication [lu:bri'keiʃən] *n.* 润滑
cleanliness ['klenlinis] *n.* 清洁(度),洁净
graphite ['græfait] *n.* 石墨
molybdenum [mɔ'libdinəm] *n.* 钼
disulfide [dai'sʌlfaid] *n.* 二硫化物
fat [fæt] *n.* 脂肪,油脂;*a.* 油脂的,多脂的
derivative [di'rivətiv] *n.* 导数,变型,改型,衍生物;*a.* 派生的,衍生的
contamination [kəntæmi'neiʃən] *n.* 污染,沾染,杂质
asperity [æs'periti] *n.* 粗糙,凹凸不平
metalworking ['metlwə:kiŋ] *n.* 金属加工
possess [pə'zes] *vt.* 具有,支配,控制
sludge [slʌdʒ] *n.* 污泥,油泥,油渣,油垢
viscous ['viskəs] *a.* 粘的,粘性的,粘稠的
viscosity [vis'kɔsiti] *n.* 粘性,粘度,滞度
abrasion [ə'breiʒən] *n.* 擦伤,磨损,磨耗,研磨
corrosion [kə'rouʒən] *n.* 腐蚀,侵蚀,锈蚀
petroleum [pi'trouljəm] *n.* 石油产品
suspend [səs'pend] *v.* 悬,吊,挂,悬浮
deteriorate [di'tiəriəreit] *v.* 变坏,降低(品质),恶化,退化,损坏,磨损
neutralize ['nju:trəlaiz] *vt.* 使中和,平衡,使中立
dampen ['dæmpən] *v.* =damp 阻尼,减振,缓冲
insulation [insju'leiʃən] *n.* 绝缘,隔热,绝缘体
transformer [træns'fɔ:mə] *n.* 变压器,互感器
switchgear ['switʃgiə] *n.* 开关装置,配电装置
dielectric [daii'lektrik] *a.* 不导电的,绝缘的,介电的
intermittent [intə'mitənt] *a.* 间歇的,断续的,周期性的
hydrostatical [haidrou'stætikəl] *a.* 流体静力(学)的,液压静力的
hydrodynamical [haidroudai'næmikəl] *a.* 流体动力(学)的,水力的

3. Machine Tool Frames

The frame is a machine's fundamental element. It carries all the active and passive components—spindles, tables, and controls .

Most frames are made from welded steel, cast iron, or composite concrete. The following factors govern material choice.

The material must resist deformation and fracture. Hardness must be balanced against elasticity. The frame must withstand impact, yet yield under load without cracking or permanently deforming. The frame material must eliminate or block vibration transmission to reduce oscillations that degrade accuracy and tool life. It must withstand the hostile shop-floor environment, including the newer coolants and lubricants. Material expansion must be understood to minimize forces needed to move slides. The material must not build up too much heat, must retain its shape for its lifetime, and must be dense enough to distribute forces throughout the machine.

Pros and Cons

Either castings or welded sections can be used in most applications. The decision on which is best depends on the costs in a given design situation.

Cast iron. Almost all machine tool frames were traditionally made of cast iron because features difficult to obtain any other way can be cast in. Castings have a good stiffness-to-weight ratio and good damping qualities. Modifying wall thickness and putting the metal where it's needed is fairly easy.

On the down side, although cast iron is a fairly cheap material, each casting requires a pattern. Larger sizes are a limiting factor because of pattern cost, problems with bolted joints, and the need to anneal castings, which is difficult and costly with larger sections.

Smaller, high-volume machines usually have cast iron frames because they more easily absorb pattern cost. Welded frames may be cheaper for lower volume machines.

Welded steel. Machine builders fabricate steel frames from welded steel sections when casting is impractical. Because steel has a higher modulus, it is usually ribbed to provide stiffness. The number of welds is a design tradeoff: with welding, it's easy to make large sections and add features even after the initial design is complete, but the heat can introduce distortion and also adds cost. Welds also help block vibration transmission through the steel frame. Builders sometimes increase damping by circulating coolant through the welded structure or adding lead or sand to frame cavities.

Composites. Advanced forms of these materials, including those with polymer, metal, and ceramic matrices, may change machine tool design dramatically. Both matrix and reinforcing material can be tailored to provide strength in specific axes.

Ceramics. The Japanese introduced experimental machine tools with ceramic frames in the 1980s. Ceramics offer strength, stiffness, dimensional stability, corrosion resistance, and excellent surface finish, but they are brittle and expensive. Their lack of conductivity can be an advantage or not. Both composite and ceramic use is limited.

Reinforced concrete. Though conventional reinforced concrete in simple sections increases mass and reduces vibration, another form, actually a polymer matrix composite made of crushed concrete or granite bound in a polymer matrix, is more popular. The composite has better damping characteristics than cast iron, can be cast into almost any shape, needs no stress relieving, and can accommodate fasteners and rails if inserts are used. However, it isn't as strong as metals and diffuses heat less efficiently.

Designers must consider the different expansion coefficients between the composite and the metal sections to which it is joined. The most common applications for this material are high-accuracy