高等学校“十三五”规划教材

机电工程专业英语

主编 施平

English in Mechatronic Engineering

哈爾濱工業大學出版社
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内 容 提 要

本书以培养学生专业英语能力为主要目标。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、机械设计制造及自动化、机械工程及自动化等专业学生的教材，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

英语作为一门主要的国际交流语言，其作用已日显重要。为了更快、更准确地了解本专业的国际发展动向，学习和借鉴国外的先进技术和管理经验，专业英语的应用能力已成为高等院校学生和科技工作者应该具备的素质之一。

编写本书的主要目的是帮助机电工程、机械设计制造及自动化、机械工程及自动化等专业的学生们提高专业英语的实际应用能力。本书初版于1996年5月，这次是在2010年第8版的基础上又做了全面修订。

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。

本书由施平主编，参加编写工作的有梅雪、田锐、胡明、李越、施晓东、魏思欣、侯双明，由贾艳敏担任主审。对书中的不足之处，恳请广大读者批评指正。

编　者

2014年10月

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1 MACHINE COMPONENTS AND DESIGN

1. Couplings, Clutches, 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 (see Fig. 1.1).

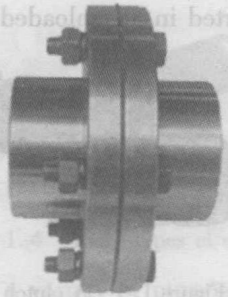


Figure 1.1 A rigid coupling

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(see Fig. 1.2). 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.

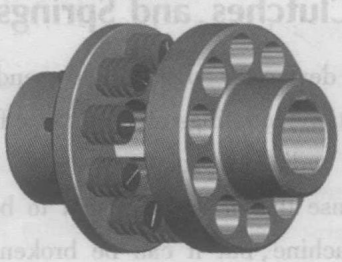


Figure 1.2 A flexible coupling

A clutch (see Fig. 1.3) 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.

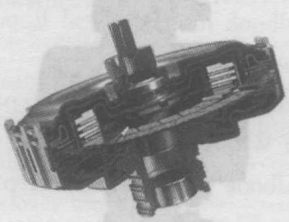


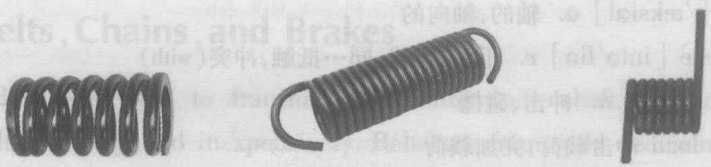
Figure 1.3 A clutch

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 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. The three major classifications of springs are compression, extension, and torsion (see Fig. 1. 4). Although most springs are mechanical and derive their effectiveness from the flexibility inherent in metallic elements, hydraulic springs and air springs are also obtainable.



(a) Helical compression spring (b) Helical extension spring (c) Helical torsion spring

Figure 1.4 Three types of springs

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 [ˈkʌpliŋ] *n.* 耦合,联轴器,连接器
clutch [klʌtʃ] *n.* 离合器;*v.* 使离合器接合
shaft [ʃɑ:ft] *n.* 轴,辊
semipermanent [ˌsemiˈpə:mənənt] *a.* 半永久性的,暂时的
in the sense that... 在…意义上
shaft coupling 联轴器
exceptionally [ikˈsepʃənli] *ad.* 格外地,特别地
line shaft 动力轴,主传动轴
propeller [prəˈpelə] *n.* 螺旋桨,推进器
couple [ˈkʌpl] *v.* 使联在一起,联接,力偶
rigid coupling 刚性联轴器,刚性联接
aligning [əˈlaigniŋ] *n.* 找正,直线对准
flexible coupling 弹性(挠性)联轴器
misalignment [ˈmisəlainmənt] *n.* 未对准,轴线不重合,安装误差
deflect [diˈflekt] *v.* 偏移,弯曲,下垂
axial [ˈæksiəl] *a.* 轴的,轴向的
interfere [intəˈfiə] *v.* 干涉,干扰,同…抵触,冲突(with)
shock [ʃɔk] *n.* 冲击,碰撞
shock load 冲击载荷,突加载荷
vibration [vaiˈbreiʃən] *n.* 振动
coaxial [kəuˈæksiəl] *a.* 同轴的,共轴的
means [ˈmi:nz] *n.* 手段,方法;*v.* 意味,想要
driver motor 主驱动电动机
rotor [ˈrəutə:] *n.* 转子,电枢,转动体

rotational inertia 转动惯量
torque [tɔ:k] *n.* 转矩,扭矩;*v.* 扭转
winding ['waindiŋ] *n.* 绕组,线圈
burn out 烧坏,烧掉
machine tool 机床
current 电流
pulley ['puli] *n.* 滑轮,皮带轮
intermediate shaft 中间轴
deflection [di'flekʃən] *n.* 偏移,偏转,弯曲,挠度
derive [di'raiv] *v.* 从…得到,获得,引伸出
inherent in 为…所固有,固有的
metallic [mi'tælic] *a.* 金属的
hydraulic [hai'drɔ:lik] *a.* 液压的
motive power 动力,原动力
cushion ['kuʃən] *n.* 缓冲器;*v.* 缓冲,减振
restrain [ris'trein] *v.* 抑制,约束,限制
mitigate ['mitigeit] *v.* 使缓和,减轻,防止
disturbing force 干扰力
delicate ['delikit] *a.* 精密的,精巧的,灵敏的

2. Belts, Chains, and Brakes

Belts are used to transmit power from one shaft to another smoothly, quietly, and inexpensively. Belts are frequently necessary to reduce the higher rotative speeds of electric motors to the lower values required by mechanical equipment. Chains provide a convenient and effective means for transferring power between parallel shafts. The function of the brake is to turn mechanical energy into heat.

There are four main belt types: flat, round, V, and synchronous. A

widely used type of belt, particularly in industrial drives and vehicular applications, is the V-belt drive. The V shape causes the belt to wedge tightly into the groove of the sheave, increasing friction and allowing high torques to be transmitted before slipping occurs. Since the cost of V-belts is relatively low, the power output of a V-belt system may be increased by operating several belts side by side (see Fig. 2.1). Another type of V-belt drive is the poly V-belt drive (see Fig. 2.2). V-belt dive helps protect the machinery from overload, and it damps and isolates vibration.

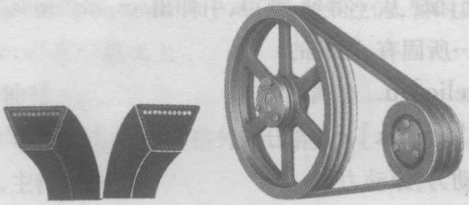


Figure 2.1 V-belts and multiple V-belt drive

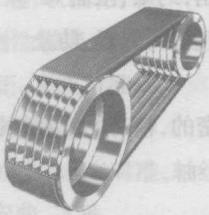


Figure 2.2 Poly V-belt drive

Other belts, such as flat belts, are used for long center distances and high speed applications. A flat belt drive has an efficiency of around 98%, which is nearly the same as for a gear drive. A V-belt drive can transmit more power than a flat belt drive. However, the efficiency of a V-belt drive varies between 70 and 96%.

Synchronous belts (also known as timing belts) have evenly spaced teeth on the inside circumference (see Fig. 2.3). Synchronous belts do not slip and hence transmits power at a constant angular

velocity ratio.

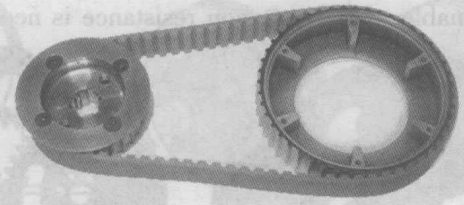


Figure 2.3 Synchronous belt drive

However, if very large ratios of speed reduction are required in the drive, gear reducers are desirable because they can typically accomplish large reductions in a rather small package. The output shaft of the gear-type speed reducer is generally at low speed and high torque. If both speed and torque are satisfactory for the application, it could be directly coupled to the driven machine.

Chain drives combine some of the more advantageous features of belt and gear drives. Chain drives provide almost any speed ratio. Their chief advantage over gear drives is that chain drives can be used with arbitrary center distances. Compared with belt drives, chain drives offer the advantage of positive (no slip) drive and therefore greater power capacity. An additional advantage is that not only two but also many shafts can be driven by a single chain at different speeds, yet all have synchronized motions. Primary applications are in conveyor systems, farm machinery, textile machinery, and motorcycles.

In chain drive applications, toothed wheels called sprockets mate with a chain to transmit power from one shaft to another (see Fig. 2.4). The most common type of chain is the roller chain (see Fig. 2.5), in which the roller on each bushing provides exceptionally low friction between the chain and the sprockets. Of its diverse applications, the most familiar one is the roller chain drive on a bicycle. A roller chain is generally made of hardened steel. Sprockets are generally made of steel or cast iron, but some applications use

aluminum alloy or plastic. Nevertheless, stainless steel and bronze chains are obtainable where corrosion resistance is needed.

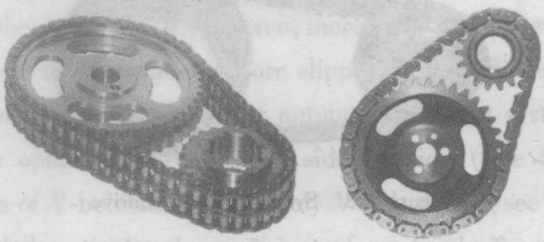


Figure 2.4 Chain drives

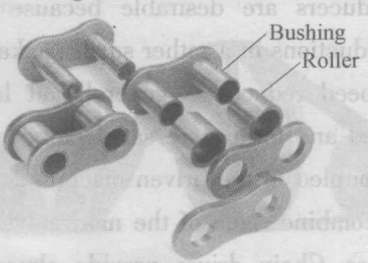


Figure 2.5 Portion of a roller chain

A brake is similar to a clutch except that one of the shafts is replaced by a fixed member. A brake is a mechanical device which inhibits motion (see Fig. 2.6). The basic function of a brake is to absorb energy (i.e., to convert kinetic and potential energy into friction heat) and to dissipate the resulting heat without developing destructively high temperatures. Clutches also absorb energy and dissipate heat, but usually at a lower rate. Where brakes are used more or less continuously for extended periods of time, provision must be made for rapid transfer of heat to the surrounding atmosphere. For intermittent operation, the thermal capacity of the parts may permit much of the heat to be stored, and then dissipated over a longer period of time. Brake and clutch parts must be designed to avoid objectionable thermal stresses and thermal distortion.

The rate at which heat is generated on a unit area of friction

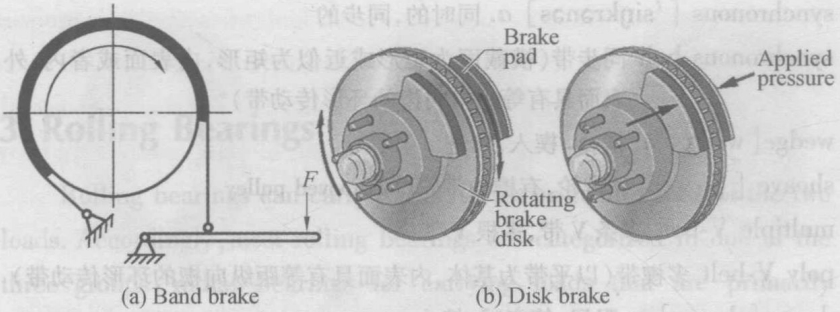


Figure 2.6 Brakes

interface is equal to the product of the normal pressure, coefficient of friction, and rubbing velocity. Manufacturers of brakes and of brake lining materials have conducted tests and accumulated experience enabling them to arrive at empirical values of pV (normal pressure times rubbing velocity) and of power per unit area of friction surface that are appropriate for specific types of brake design, brake lining material, and service conditions.

Words and Expressions

belt drive 带传动(由柔性带和带轮组成传递运动和动力的机械传动,分摩擦传动和啮合传动)

chain drive 链传动(利用链与链轮轮齿的啮合来传递动力和运动的机械传动)

rotative ['rəutətiv] *a.* 回转的,转动的

brake [breik] *n.* 制动器(具有使运动部件减速、停止或保持停止状态等功能的装置)

vehicular [vi'hikjulə] *a.* 车辆的,运载工具的

flat belt 平带(横截面为矩形或近似为矩形的传动带,其工作面为宽平面)

round belt 圆带(横截面为圆形或近似为圆形的传动带)

V-belt V 带(横截面为等腰梯形或近似为等腰梯形的传动带,其工作面为两侧面)

synchronous [ˈsiŋkrənəs] *a.* 同时的,同步的

synchronous belt 同步带(横截面为矩形或近似为矩形,内表面或者内、外表面具有等距横向齿的环形传动带)

wedge[wedʒ] *n.* 楔;*v.* 楔入,楔进

sheave [ʃi:v] *n.* V 带轮,有槽的带轮,即 grooved pulley

multiple V-belt 多条 V 带,多根 V 带

poly V-belt 多楔带(以平带为基体,内表面具有等距纵向楔的环形传动带)

damp [dæmp] *v.* 阻尼,使衰减,抑止

timing belt 同步齿形带

conveyor [kənˈveiə] *n.* 输送机(具有输送功能的机械)

roller chain 滚子链(组成零件中具有回转滚子,且滚子表面在啮合时直接与链轮齿接触的链条)

positive (no slip) drive 强制(无滑动)传动

sprocket [ˈsprɔkit] *n.* 链轮

bushing [ˈbuʃiŋ] *n.* 套筒

hardened steel 淬硬钢,淬火钢

dissipate [ˈdisipeit] *v.* 消散

thermal distorsion 热变形

band brake 带式制动器(用制动带的内侧面作为摩擦副接触面的制动器)

disk brake 盘式制动器(用圆盘的端面作为摩擦副接触面的制动器)

brake lining 制动衬片,摩擦片,制动衬带

brake pad 摩擦衬块,制动衬块

brake disk 制动盘(以端平面为摩擦工作面的圆盘形运动部件)

product 乘积

normal pressure 正压力

rubbing velocity 摩擦速度

service condition 使用条件,工作条件,使用状态