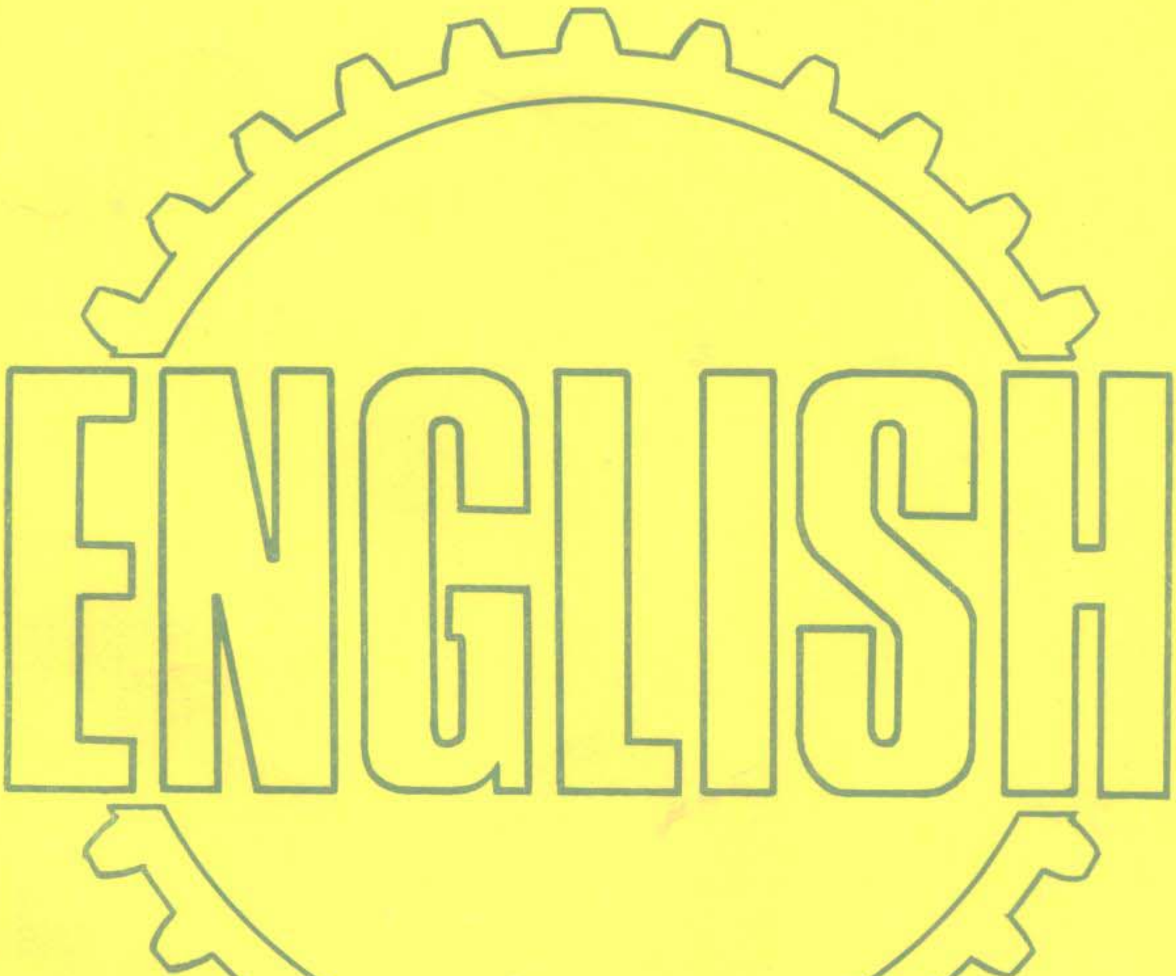
机械制造工程专业英语

周菊琪　徐旭东　编



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编　　者：周菊琪　徐旭东　编
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内 容 提 要

本书以培养学生专业英语阅读和英译中能力为主要目标，体系新颖、内容覆盖面广，突破了传统类似教材的模式。

全书共三章，主要内容为机械构件、机床结构及工艺、现代控制技术及其发展。每课附有单词、注释、参考译文及英译中练习。书后附录内容丰富，具有较强的实用性和知识延伸性。

本书可作为高等学校机械制造工程类及相关专业的教材，也适用于成人教育及职工培训，并可供制造工程技术人员、外贸人员及有关专业师生参考。

前　言

当今世界上，制造技术和装备的发展势头迅猛异常，以机床为核心的加工设备和制造技术组成了现代机械工业的基础。在我国，制造技术和设备的引进，外向型经济的发展，导致对具有专业英语能力的人才需求激增。

酝酿多年，受多方委托，在自编教材，多年从事专业笔译和专业英语教学实践的基础上，尝试编写了《机械制造工程专业英语》教材，供机械制造工程有关专业和工程技术人员之急需。

全书共分三章。第一章为机械构件，第二章为机床结构及工艺，第三章为现代制造技术及其发展，共20课。每课附有单词、注释、参考译文和与课文内容相呼应的短文英译中练习。附录部分的内容有金属切削机床术语(中英对照)；引进机械设备随机技术文件目录实例(中英对照)；机械制造工程论文格式及实例；美国含机械工程系的大学汇总；国内外机械制造工程学术团体名称及学科分类；国内外制造技术主要刊物名录汇总等。

课文内容体系新颖，选材先进，文体难度适中。编排的内容既对现设技术基础课、专业课、选修课进行必要的重迭和覆盖，又有所拓宽和延伸，力求反映现代制造技术的现状和总的趋势。全书注重提高学生阅读专业书刊、阅读和翻译引进设备技术文件、用英语撰写专业论文等方面的能力。

本书可作为高等工业院校机制类专业以及相近专业的教材，也可供从事制造工程的工程技术人员和研究生参考。略加增删也可用作大专及非全日制学生的教材。

本书在编写过程中得到中国生产工程学会遇立基秘书长、机床工具协会杨天鹏高级工程师、中国机床总公司、机床杂志编辑部、兄弟院校和有关企业的支持和帮助，在此一并表示衷心的感谢。

全书由北京机械工业学院、全国高等学校专业教学指导委员会委员、全国机械控制工程研究学会副理事长朱骥北教授主审。

限于编者的水平，书中错误或不妥之处在所难免，敬希读者指正。

编者
1992年4月于江南大学

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Chapter One　Mechanics Components
第一章　机械构件

Lesson One　Gears
第一课　齿轮

Spur and helical gears. A gear having tooth elements that are straight and parallel to its axis is known as a spur gear. A spur pair can be used to connect parallel shafts only. Parallel shafts, however, can also be connected by gears of another type, and a spur gear can be mated with a gear of a different type (Fig. 1-1).

To prevent jamming as a result of thermal expansion, to aid lubrication, and to compensate for unavoidable inaccuracies in manufacture, all power-transmitting gears must have backlash. This means that on the pitch circles of a mating pair, the space width on the pinion must be slightly greater than the tooth thickness on the gear, and vice versa. On instrument gears, backlash can be eliminated by using a gear split down its middle, one half being rotatable relative to the other[①] A spring forces the split gear teeth to occupy the full width of the pinion space.

Helical gears have certain advantages; for example, when connecting parallel shafts they have a higher loadcarrying capacity than spur gears with the same tooth numbers and cut with the same cutter. Because of the overlapping action of the teeth, they are smoother in action and can operate at higher pitch-line velocities than spur gears. The pitch-line velocity is the velocity of the pitch circle. Since the teeth are inclined to the axis of rotation, helical gears create an axial thrust. If used singly, this thrust must be absorbed in the shaft bearings. The thrust problem can be overcome by cutting two sets of opposed helical teeth on the same blank. Depending on the method of manufacture, the gear may be of the continuous-tooth herringbone variety or a double-helical gear with a space between the two halves to permit the cutting tool to run out. Double-helical gears are well suited for the efficient transmission of power at high speeds.

Helical gears can also be used to connect nonparallel, non-intersecting shafts at any angle to one another. Ninety degrees is the commonest angle at which such gears are used.

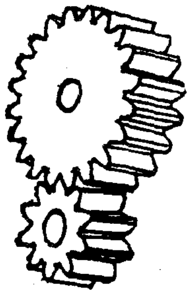

Fig 1-1 Spur gears

Worm and bevel gears. In order to achieve line contact and improve the load-carrying capacity of the crossedaxis helical gears, the gear cân be made to curve partially around the pinion, in somewhat the same way that a nut envelops a screw②. The result would be a cylindrical worm and gear.

Worm gears provide the simplest means of obtaining large ratios in a single pair. They are usually less efficient than parallel-shaft gears, however, because of an additional sliding movement along the teeth. Because of their similarity, the efficiency of a worm and gear depends on the same factors as the efficiency of a screw. Single-thread worms of large diameter have small lead angles and low efficiencies. Multipie-thread worms have larger lead angles and higher efficiencies (Fig. 1-2).

For transmitting rotary motion and torque around corners, bevel gears are commonly used. The connected shafts, whose axes would intersect if extended, are usually but not necessarily at right angles to one another.

When adapted for shafts that do not intersect, spiral bevel gears are called hypoid gears. The pitch surfaces of these gears are not rolling cones, and the ratio of their mean diameters is not equal to the speed ratio. Consequently, the pinion may have few teeth and be made as large as necessary to carry the load.

The profiles of the teeth on bevel gears are not involutes; they are of such a shape that the tools for cutting the teeth are easier to make and maintain than involute cutting tools. Since bevel gears come in pairs, as long as⑤ they are conjugate to one another they need not be conjugate to other gears with different tooth numbers.

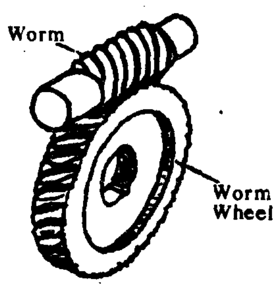

Fig 1-2 Worm gear set

Words and Expressions

1. spur gear	n. 直齿轮
2. thermal expansion	n. 热膨胀
3. lubrication	n. 润滑
4. backlash	n. 侧向间隙
5. the pitch circles	n. 节圆
6. space width	n. 间隙宽度
7. instrument gear	n. 仪表齿轮
8. the split gear	n. 拼合齿轮
9. helical gear	n. 斜齿轮
10. pitch-line velocities	n. 节线速度
11. an axial thrust	n. 轴向推力
12. blank	n. 坯件
13. double-helical gears	n. 人字齿轮
14. non-intersecting	n. 不相交的
15. worm gears	n. 蜗轮蜗杆
16. bevel gears	n. 伞齿轮
17. crossed-axis	n. 交叉轴
18. nut	n. 螺母
19. screw	n. 丝杠，螺钉
20. large ratios	n. 大速比
21. parallel-shaft gears	n. 平行轴齿轮
22. single-thread worms	n. 单线蜗杆
23. lead angles	n. 导角
24. multiple-thread worms	n. 多线蜗杆
25. hypoid gear	n. 偏轴伞齿轮
26. rolling Cones	n. 滚锥
27. involutes	n. 渐开线

Notes

1. On instrument gears, backlash can be eliminated by using a gear split down its middle, one half being rotatable relative to the other.

在仪表齿轮上可以利用从中间分开的拼合齿轮来消除侧向间隙，它的一半可相对于另一半转动。其中 one half being rotatable ……为复合结构，表示伴随情况。

2. In order to achieve line contact and improve the loadcarrying capacity of the crossed-axis helical gears, the gear can be made to curve partially around the pinion, in somewhat the same way that a nut envelops a screw.

为了使交叉轴斜齿轮获得线接触并改进其承载能力，可以把大齿轮做成弯曲的部分包在小齿轮上，有点像螺母套在螺钉上一样。

Exercises

Put the following into Chinese:

Gear trains The maximum gear ratio obtainable with a single of gears varies with the type of gear and the application. The following are approximate maxima for the various types for average load conditions: spur, 8; parallel-shaft helical, 10; straight bevel, 6; spiral bevel, 8; hypoid, 12; and worm, 80. For lightly loaded, instrument, and positioning gears, these ratios can be exceeded. Ratios as high as 400 or higher can be obtained with gears that resemble tapered worms meshing with hypoid gears. For heavily loaded gears, the given ratios may be so high that a reasonable gear size precludes a satisfactory pinion.

Since the ratio in a single pair of gears is the quotient of the tooth numbers, and since there usually are limitations on both the minimum and maximum numbers of teeth on the available gears, it follows that the number of ratios obtainable in a single pair is limited. To enlarge the coverage it is necessary to use multiple pairs, or trains The overall speed ratio in a train is the product of the ratios in each pair. In certain cases an exact ratio cannot be obtained with gears, but by using two or more pairs, the desired ratio can be approximated to any degree of precision.

Lesson Two　Rolling Guides and Bearings
第二课　滚动导轨和轴承

Rolling guides

Rolling linear guides and guideways are widely used in practice, alongside plain linear guides. The following advantages ate obtained when compared with plain guides: light running forces due to rolling friction, no stick-slip, trouble-free installation and immediate availability due to standardization of the rolling elements.

The main disadvatage of this type of guide when compared with hydrostatic and hydrodynamic guides lies in the low damping effects in the direction normal to the movement.

Figure 1-3 shows in its upper section a rolling guide using a roller chain. Generally, rolling elements travel half the distance moved by the slide. When roller chains are employed, their length must at least equal the sum of half the slide travel plus its own length. Hence, for long movements rolling guideways in general employ recirculating roller elements, as shown in the lower half of Fig. 1-3. In this case the rollers run in an endless track, so that the movement is limited only by the length of the running surface.

For accurate operation of the complete rolling guideway, consideration must not only be given to the quality of both guiding surfaces but also to the dimensional and geometric accuracy of the rolling elements and their control in the cage. When cylindrical rollers are used, inaccurate cages as well as non-parallel guideway surfaces can lead to angular motion and side thrust of the rollers on the cage, which in turn will result in damage to the guiding surfaces and the cage itself, due to the friction generated. This problem is not encountered when balls are used as rolling elements, but such guides have the disadvantage of even lower stiffness and load-carrying capacity when compared with roller linear guides (point contact instead of line contact).

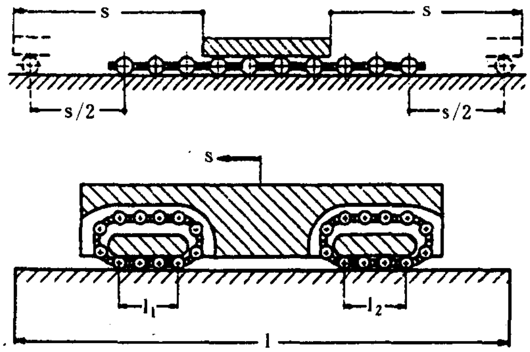

Fig 1-3 Principles of construction for linear roller guides (Schneeberger)

Rolling-contact bearings. *Ball bearings.* Figure 1-4 (top) Shows two views of one quarter of the most widely used type of modern ball bearing. It consists of four parts: an inner race *b*, an outer race *c*, the balls *d*, and a separator or retainer *e*, which is also called a cage.

The races in which the balls roll have grooves with radii of curvature slightly greater than the radius of a ball.① Some bearings are assembled by moving the inner race radially, inserting the balls, centring the inner race, spacing the balls uniformly, and applying the retainer that holds the balls loosely in an equally spaced position. Other bearings have a notch in one of the races that permits more balls to be inserted. With more balls, the bearing can carry more radial load *R* (Figure 1-4 [top]) but less thrust load *T* on account of the notch.

Although the bearing in Figure 1-4 (top) is classified as a radial ball bearing, it has considerable thrust or axialload capacity. The thrust capacity *T* can be increased by extending the races to sections *ff* so that the groove in the outer race is deeper on the left side and the groove in the inner race is deeper on the right side; some angular-contact bearings are made like this. If all of the load on a bearing is axial, an axial-thrust bearing can be used. This is simply two grooved washers with balls between them.

Roller bearings. These bearings have rollers instead of balls between the races. The rollers may be cylindrical, tapered, or spherical. Cylindrical roller bearings have rollers with a length to diameter ratio of about one and run in cylindrical races, one of which may have retaining shoulders; they cannot carry a thrust load. ② Needle bearings have long, small-diameter rollers and may be installed with or without retainers and with or without races.

Needle bearings cannot carry thrust loads, but they have the highest radial load capacity.

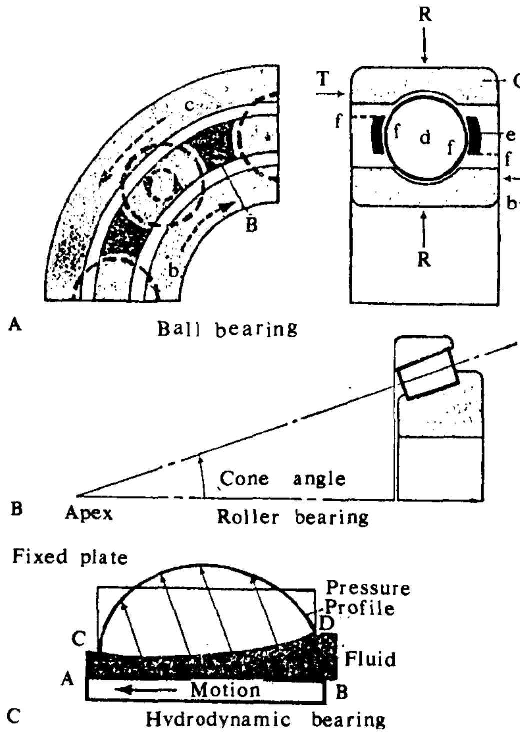

Fig 1-4 Types of bearings

Tapered roller bearings (Figyre 1-4) have a high load capacity and when used in opposed pairs can carry thrust loads in either direction. Spherical roller bearings have either convex or concave rollers in both single and double rows.

All these bearings have a self-aligning ability obtained by grinding either the outer or inner race spherical. The most commonly used type of spherical roller bearing is the double-row bearing with convex rollers.

Words and Expressions

1. rolling guides (rolling guideways) n. 滚动导轨
2. plain guides n. 普通导轨
3. a roller chain n. 滚柱链
4. cape n. 保持架
5. guide surfaces n. 导轨面
6. stiffness n. 刚性
7. load-carrying capacity n. 载荷能力
8. rolling-contact bearings n. 滚动轴承
9. ball bearings n. 球轴承
10. an inner race n. 内座圈

11. an outer race	n. 外座圈
12. separator	n. 隔离环
13. curvature	n. 曲率
14. notch	n. 凹槽
15. thrust load	n. 推力负载
16. a radial ball bearing	n. 经向球轴承
17. sections	n. 断面
18. an axial-thrust bearing	n. 轴向推力轴承
19. washer	n. 垫圈
20. roller bearing	n. 滚子轴承
21. tapered	a. 锥形的
22. spherical	a. 球面的
23. retaining shoulder	n. 定位肩
24. needle bearing	n. 滚针轴承
25. tapered roller bearings	n. 锥形滚子轴承
26. spherical roller bearings	n. 球面滚子轴承
27. convex	a. 凸面的
28. concave	a. 凹面的

Notes

1. The races in which the balls roll have grooves with radii of curvature slightly greater than the radius of a ball.

滚子滚动的内外座圈都开有凹槽，其曲率半径稍大于滚珠的半径。其中 in which the balls roll 为定语从句，修饰 the races。

2. Cylindrical roller bearings have rollers with a length to diameter ratio of about one and run in cylindrical races, one of which may have retaining shoulders; they cannot carry a thrust load.

圆柱滚子轴承滚子的长度与直径之比约为1: 1，滚子在圆柱座圈里滚动，其中一个座圈为定位肩，这种轴承不能承受推力负荷。其中 one of which …… shoulders 为定语从句，修饰 races。

Exercises

Put the following into Chinese:

Self-Aligning Ball Bearings

Self-aigning ball bearings normally have two rows of balls that roll in a common spherical race in the outer ring, as shown in Figure. Because of this design, the inner ring, with the ball complement, can ailgn itself freely around the axis of the shaft. When the shaft bends under load, the bearing will follow the deflection of the shaft without resistance. Self-alignment also contributes to smooth runing by neutralizing the effect of the balls wobbling in the grooves. This bearing is therefore particularly useful in applications in which it is difficult to obtain exact parallelism between the shaft and housing bores.

Thrust Ball Bearings

The simplest form of thrust ball bearings is shown in Figure. In this type of bearing, a single row of balls set in a separator runs in two similar grooves formed in the stationary and revolving rings. The revolving ring is fixed to a shaft. These grooves are usually shallower than the groove in a deep-groove radial ball bearing. Thrust ball bearings are designed to carry pure thrust load and if any radial load is present, separate radial bearings must be used. From the viewpoint of both economics and simplicity of design, it is wise to seck the use of an angular-contact bearing where both radial and thrust loads are present.

Lesson Three Clutches
第三课 离合器

A clutch is a device for quickly and easily connecting or disconnecting a rotatable shaft and a rotating coaxial shaft.

Friction clutches.

Friction clutches have pairs of mating conical, disk, or ring-shaped surfaces and means for pressing the surfaces together. The pressure may be created by a spring or by a series of levers locked in position by the wedging action of a conical spool.① On a spring-loaded clutch the operator, by controlling the rate at which the spring pressure is applied to the clutch, can regulate the speed of clutch engagement and the torque applied to the driven shaft. There is always some slippage, however, and the efficiency of a friction clutch can never exceed 50 percent; *i.e.*, during a clutching operation at least one-half of the input energy is lost by friction in the clutch and produces heat.

The friction surfaces on clutches should have a high coefficient of friction and be able to conduct the heat away rapidly. These properties are difficult to obtain in a single material and for this reason, one of each pair of mating surfaces is usually metallic, while the other is either leather, cork, or an asbestos-based facing rivetted to a metal plate. Some friction clutches are run dry, while others operate in oil. Dry clutches have a higher coefficient of friction than wet clutches, but the oil helps to carry off the heat.

Figure 1-5 shows a half-section of a multiple-plate disk clutch in which input member 2 is keyed to the driving shaft 1 and output member 3 is keyed to the driven shaft 4. The friction plates b have external gear teeth or splines that mate with teeth on the inside of member 2, while friction plates c have internal teeth that mate with external teeth on member 3. Plates b can slide axially in 2, while plates c can slide axially on 3. The clutch is engaged by moving the spool to the left, which, by a wedging action, rotates the lever about the pivot p and creates a force that squeezes the plates together.