中国交通教育研究会(港口)职工分会组织编写
港口主体工种职业培训教材

GANGKOU JIXIE YINGYU

港口机械英语

主　编　仇桂玲　董　丽
副主编　刘洪新　王宝昌
主　审　杨丽红

人民交通出版社
China Communications Press

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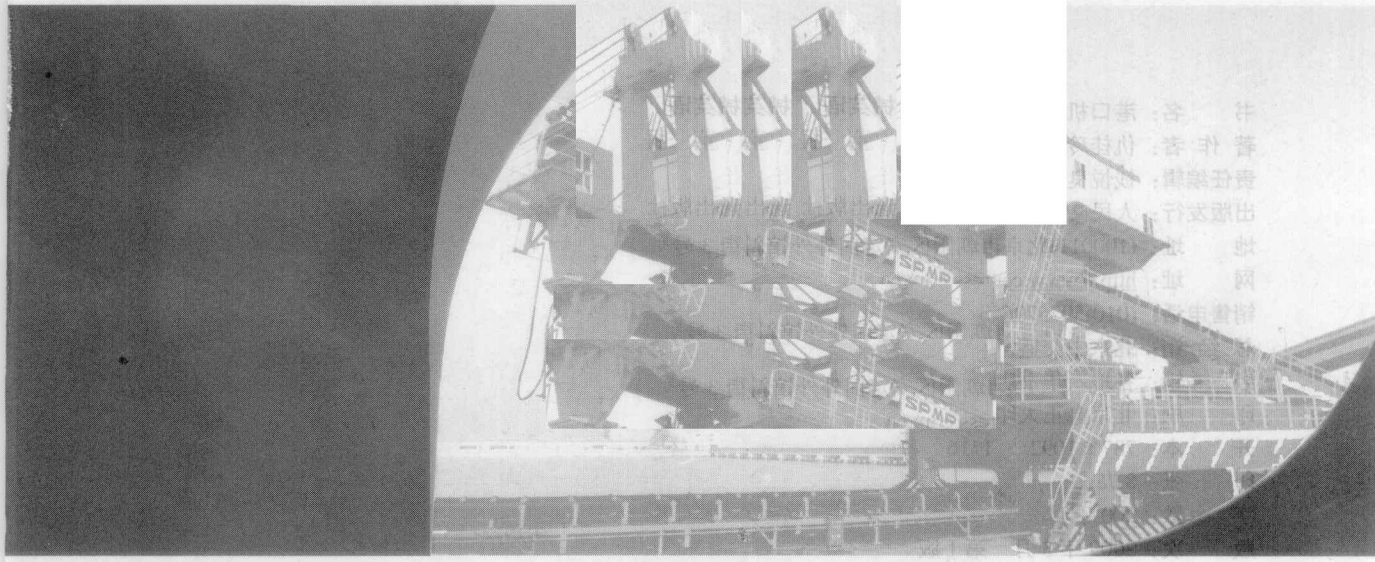


人民交通出版社

内 容 提 要

本书是港口机械专业英语阅读教材，共分为5章，精选了港口机械专业方面的文章62篇，主要内容包括：机械原理，港口电气设备，港口机械设备简介，港口机械设备维护以及港口机械设备规格等。

本书可供港口机械设备管理及相关专业人员参考使用。

图书在版编目（CIP）数据

港口机械英语/仇桂玲，董丽主编. —北京：人民交通出版社，2009.3
ISBN 978-7-114-07620-6

Ⅰ.港… Ⅱ.①仇… ②董… Ⅲ.港口机械-英语-高等学校-教材 Ⅳ.H31

中国版本图书馆CIP数据核字（2009）第021150号

书　　名：港口机械英语
著 作 者：仇桂玲　董　丽
责任编辑：钱悦良
出版发行：人民交通出版社
地　　址：(100011)北京市朝阳区安定门外外馆斜街3号
网　　址：http://www.ccpress.com.cn
销售电话：(010)59757969，59757973
总 经 销：北京中交盛世书刊有限公司
经　　销：各地新华书店
印　　刷：北京鑫正大印刷有限公司
开　　本：787×1092　1/16
印　　张：8.75
字　　数：200千
版　　次：2009年3月　第1版
印　　次：2009年3月　第1次印刷
书　　号：ISBN 978-7-114-07620-6
印　　数：0001－4000册
定　　价：18.00元
（如有印刷、装订质量问题的图书由本社负责调换）

前　言

为适应港口建设和发展的需要，促进港口高技能人才的培养，2006年中国交通教育研究会（港口）职工分会教材编审委员会依据《交通行业职业技能标准》的要求，编写了《港口主体工种技师、高级技师培训教学计划及教学大纲》。

2007年，中国交通教育研究会（港口）职工分会教材编审委员会按照《港口主体工种技师、高级技师培训教学计划及教学大纲》的要求，组织编写了《港口内燃装卸机械检测》、《港口内燃装卸机械控制技术》、《港口电动装卸机械检测》、《港口电动装卸机械控制技术》、《港口装卸机械电气设备基础》、《港口装卸机械电气控制技术》、《港口机械英语》七册教材，并对2004年出版的《港口机械设备管理》一书作了修订。

本套教材从港口高技能人才培训的实际需要出发，除《港口机械英语》、《港口机械设备管理》为通用培训教材外，其余六册均采用了驾驶与修理合编，技师与高级技师合编的编写方法，并在教材后附有相关主体工种培训的教学计划和教学大纲。教材在编写过程中，参考了各港口有关教材及培训资料，注重理论知识与港口生产实际相结合，引入了新知识、新技术、新工艺。因此本套教材具有较高的针对性、通用性、实用性和先进性，适应了港口生产的发展变化，以求满足技术工人成长及港口主体工种技师、高级技师职业技能鉴定考核的需要。

由于港口主体工种所涉及机械、电气设备种类繁多，结构各异，在使用中，教学培训负责人和教师应按学员工种和级别的不同，以及各港使用和维修设备的不同，在给定课时范围内，有针对性地选择书中有关章节进行讲授。

本书是港航机械专业的英语阅读教材，共分为5章，精选了港航机械专业方面的文章62篇，主要内容包括：机械原理，港口电气设备，港口机械设备简介，港口机械设备维护以及港口机械设备规格等。可供港口机械设备管理及相关人员参考使用。

本书由青岛港湾职业技术学校仇桂玲、董丽任主编，刘洪新、王宝昌任副主编。具体编写分工为：董丽（第一、二章），仇桂玲（第三章），刘洪新（第四章），王宝昌（第五章）。全书由秦皇岛港教育培训中心杨丽红主审。

另外，本套教材在编写过程中，得到了秦皇岛港、上海港、广州港、天津港、大连港、宁波港、青岛港湾职业技术学院、湛江港、南京港有关部门领导及专家们的热情支持与帮助，原中国交通教育研究会（港口）职工分会理事长林洁敏同志、副理事长王棣海同志在任职期间，原中国交通教育研究会（港口）职工分会秘书长杨振翔同志及现任秘书冯丽同志都对本套教材的编写进行了积极有效的工作，在此一并表示感谢。

由于编者能力和时间所限，教材中存在的问题和缺陷在所难免，敬请各位专家和读者批评指正。

中国交通教育研究会（港口）职工分会

教材编审委员会

二〇〇八年五月

CONTENT

Chapter 1 Mechanical Principle

Lesson 1 Steel

Generally speaking, there are two kinds of steels in common use: plain carbon steels and alloy steels. Firstly, let's look at plain carbon steels.

Plain carbon steels are the steels that contain only carbon and no other major alloying elements. This kind of steel has 3 types which are low-carbon steel, medium-carbon steel and high-carbon steel. They get their special names from their content of carbon.

If the carbon content is lower than 0.25%, it is called low-carbon steel. It cannot be hardened but can be case-hardened. It has these characteristics which are easy machining & forming, comparatively less strength, least expensive, comparatively less hardness and largest quantity produced. In practice use, bolts, nuts, washers, sheet steel, and shafts use low-carbon steel.

Medium-carbon steel contains from 0.25-0.60 percent carbons. This kind of steel is mostly used in situation where greater tensile strength is required. This kind of steel may be hardened for it has higher carbon content. Its characteristics are as follows, hard & strong after heat treating; medium depth of hardness and more expensive than low carbon steel. Tools such as wrenches, hammers, and screwdrivers are drop-forged from medium-carbon steel and later heat treated.

High-carbon steel (also named as tool steel) contains over 0.60 percent carbon, and it can contain as high as 1.7 percent. It has these characteristics: hard & strong after heat treating; depth of hardness increases and more expensive than low & medium carbon steels . Cutting tools, punches, taps, dies, drills and reamers usually use this kind of steel.

Then is the alloy steels. Alloy steel is the steel whose characteristics are determined by the addition of other elements in addition to carbon. Alloy steels have some special characteristics which are not found in plain carbon steels, so alloy steels are widely used in practice. That is to say, sometime we prefer alloy steel to plain steel.

Alloy steel has these following characteristics: it increases in tensile strength, hardness, toughness, antiwear property, corrosion resistance and red-hardness.

NEW WORDS AND EXPRESSIONS

steel *n.*	钢，钢铁
plain carbon steel	碳素钢
alloy steel	合金钢

low-carbon steel	低碳钢
medium-carbon steel	中碳钢
high-carbon steel	高碳钢
content *n.*	含量
case-harden	表面硬化
hardness *n.*	硬度
characteristic *n.*	特性
tensile strength	抗拉强度
toughness *n.*	韧性
antiwear property	抗磨性能
corrosion resistance	耐蚀性
red-hardness	红硬性

Lesson 2 Heat Treatment of Metals

Heat treatment is the operation of heating and cooling a metal in its solid state to change its properties.

Heat treatment is often associated with increasing the strength of material, but it can also be used to alter certain manufacturability objectives such as improve machining, improve formability, restore ductility after a cold working operation. Thus it is a very enabling manufacturing process that can not only help other manufacturing process, but can also improve product performance by increasing strength or other desirable characteristics.

With the proper heat treatment, internal stresses may be removed, grain size reduced, toughness increased, or a hard surface produced on a ductile interior. Steels are particularly suitable for heat treatment, since they respond well to heat treatment and the commercial use of steels exceeds that of any other materials. Steels are heat treated for one of the following reasons:

1. softening;
2. hardening;
3. material modification.

Common Heat Treatments

Softening:

Softening is done to reduce strength or hardness, remove residual stresses, improve toughness, restore ductility, refine grain size or change the electromagnetic properties of the steel.

Restoring ductility or removing residual stresses is a necessary operation when a large amount of cold working is to be performed, such as in a cold-rolling operation or wiredrawing. Annealing—full Process, spheroid zing, normalizing and tempering—austempering, martempering are the principal ways by which steel is softened.

Hardening:

Hardening of steels is done to increase the strength and wear properties. One of the prerequisites for hardening is sufficient carbon and alloy content. If there is sufficient carbon content, then the steel can be directly hardened. Otherwise the surface of the part has to be carbon enriched using some diffusion treatment hardening techniques.

Material Modification:

Heat treatment is used to modify properties of materials in addition to hardening and softening. These processes modify the behavior of the steels in a beneficial manner to maximize service life, e. g., stress relieving, or strength properties, e. g., cryogenic treatment, or some other desirable properties, e. g., spring aging.

Tempering is a process done subsequent to quench hardening. Tempering is done immediately after quench hardening. When the steel cools to about 40℃ (104℉) after quenching, it is ready to be tempered. The part is reheated to a temperature of 150 to 400℃ (302 to 752℉). In this region a softer and tougher structure Troostite is formed. Alternatively, the steel can be heated to a temperature of 400 to 700℃ (752 to 1292℉) that results in a softer structure known as Sorbite. This has less strength than Troostite but more ductility and toughness.

Generally speaking, the purposes of annealing are: alteration of ductility and toughness, induction of softness and refinement of grain structure and removal of gases and stresses.

This process of normalizing is very similar to annealing, which improves strength and machinability.

Spheroidizing is a form of annealing consisting of prolonged heating of iron base alloys at a temperature in the neighborhood of, but generally slightly below the critical range, usually followed by a relatively slow cooling. Spheroidizing causes the graphite to assume a spheroidal shape, hence the name.

NEW WORDS AND EXPRESSIONS

heat treatment	热处理
manufacturability	可制造性
formability *n.*	成型性能
ductility *n.*	延展性，柔软性
internal stress	内应力
soften *v.*	软化
hardening *n.*	硬化
material modification	材料改性
tempering *n.*	回火
quench hardening	淬火硬化
stress relieving	应力消除
quenching *n.*	淬火
Troostite *n.*	屈氏体

Sorbite *n.*	索氏体
machinability *n.*	可加工性
spheroidizing *n.*	球化(处理)

Lesson 3 Introduction to Bearings

Stop and consider how many things in your life turn or revolve. Skate wheels, electric motors, car wheels, microwave turntables, even your PC has bearings in it.

The humble bearing makes many of today's machines a reality. Without them we would not be able to make precision items on a massive scale and things would wear out quickly due to excessive friction. This page is designed to give you an idea of what bearings are, what they do and the formats they come in.

All things roll and rotate better than they slide. If the wheel did not exist we would be stuck with sliding things everywhere. Consequently little progress in the world would be achieved. Sliding causes friction. Friction is caused by two surfaces resisting movement between them. However, if two surfaces can contact each other by rolling, then friction problems are significantly reduced.

How bearings 'bear' load?

Ball bearings are typically capable of dealing with two kinds of loading condition; radial load and thrust load. Depending on the type of application the bearing is used in, it may experience radial load only, thrust load only or a combination of both. A classic example being the car wheel is as shown below (See fig 3-1).

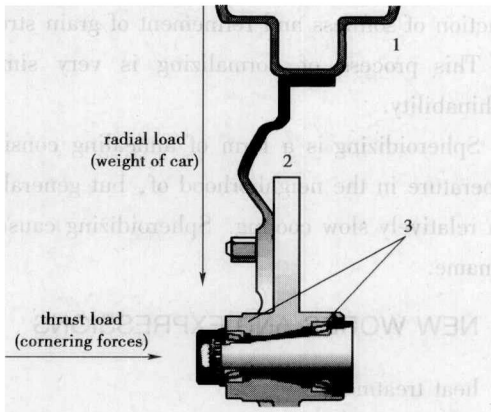


Fig 3-1 car wheel

1-wheel rim;2-hub;3-tapered roller bearings

Different types of bearings

There are many types of bearings, including ball bearings, roller bearings, ball thrust bearings, roller thrust bearings and tapered roller bearings. And each is used for different purposes either singularly or in combinations.

1. Ball bearing

Ball bearings, as shown in fig 3-2, are the most common type by far. They are found in everything from skate boards to washing machines, or to PC hard drives. These bearings are capable of taking both radial and thrust loads, and are usually found in applications where the load is light to medium and is constant in nature (i.e. not shock loading). The bearing shown here has the outer ring cut away revealing the balls and ball retainer.

2. Roller bearings

Roller bearings shown in fig 3-3 are normally used in heavy duty applications such as conveyer belt rollers, where they must hold heavy radial loads. In these bearings the roller is a cylinder, so

the contact between the inner and outer race is not a point (like the ball bearing above) but a line. This spreads the load out over a larger area, allowing the roller bearing to handle much greater loads than a ball bearing. However, this type of bearing cannot handle thrust loads to any significant degree. A variation of this bearing design is called the needle bearing. The needle roller bearing uses cylindrical rollers like those above but with a very small diameter. This allows the bearing to fit into tight places such as gear boxes that rotate at higher speeds.

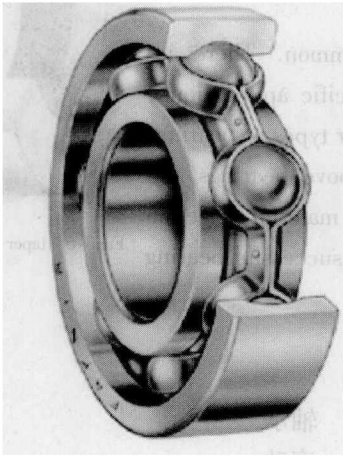


Fig 3-2 ball bearing

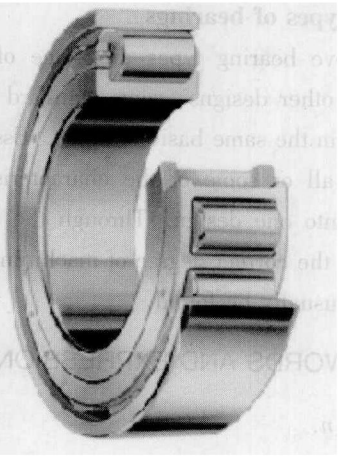


Fig 3-3 roller bearing

3. Thrust ball bearings

Ball thrust bearings like the one shown in fig 3-4 are mostly used for low-speed non-precision applications. They cannot take much radial load and are usually found in turntables and low precision farm equipment.

4. Thrust roller bearings

Thrust roller bearings like the one illustrated in fig 3-5 can support very large thrust loads. They are often found in gear sets like car transmissions between gear sprockets, and between the housing and the rotating shafts. The helical gears used in most transmissions have angled teeth; this can causes a high thrust load that must be supported by this type of bearing.

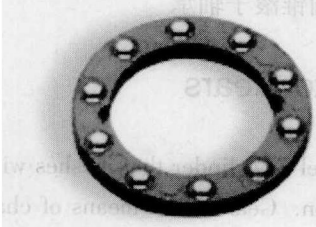


Fig 3-4 thrust ball bearing

Fig 3-5 thrust roller bearing

5. Taper roller bearings

Tapered roller bearings (see fig 3-6) are designed to support large radial and large thrust

loads. These loads can take the form of constant loads or shock loads. Tapered roller bearings are used in many car hubs, where they are usually mounted in pairs facing opposite directions. This gives them the ability to take thrust loads in both directions. The cutaway taper roller in the fig 3-6 shows the specially designed tapered rollers and demonstrates their angular mounting which gives their dual load ability.

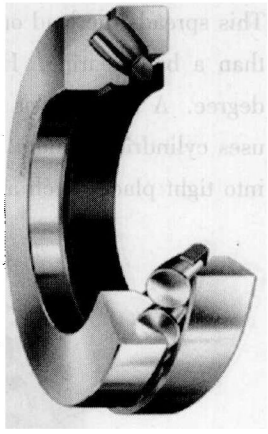


Fig 3-6 taper roller bearing

Other types of bearings

The above bearing types are some of the most common. There are thousands of other designs, some standard and some specific applications, but all perform the same basic function. Essentially further types of bearings usually take all or some of the characteristics of the above bearings and blend them into one design. Through the use of careful material selection and applying the correct degree of machining precision, a successful bearing solution can usually be found.

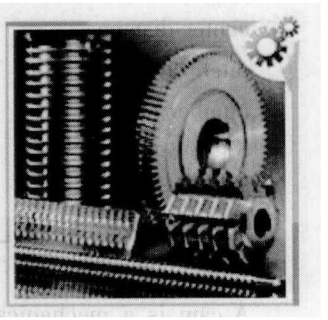
NEW WORDS AND EXPRESSIONS

bearing *n.*	轴承
roll *v.*	滚动
rotate *v.*	旋转
slide *v.*	滑动
friction *n.*	摩擦
bear *v.*	承受
radial load	径向载荷
thrust load	推力载荷
ball bearing	球轴承
roller bearing	圆柱滚子轴承
ball thrust bearing	推力球轴承
roller thrust bearing	推力圆柱滚子轴承
tapered roller bearing	圆锥滚子轴承

Lesson 4 Introduction to Gears

Gear(fig 4-1) is a toothed machine part, such as a wheel or cylinder that meshes with another toothed part to transmit motion or to change speed or direction. Gears are a means of changing the rate of rotation of a machinery shaft.

Mechanical engineers sometimes don't use gears and rely on the advent of electronic control and the availability of toothed belts because gears for high power machinery are difficult to design. Even though for high power machinery like automotive transmission, gears are the optimal medium



for high accuracy and low energy loss.

Gears are of several categories and can be combined in a multitude of ways, some of which are meshing circular spur gears, rack and pinion spur gears, and worm gears. Helical and herringbone gears utilize curved teeth for efficient, high-capacity power transmission. Worm gears, driven by worms transmit motion between non-intersecting right-angle axes. Gears mate or mesh via teeth with a very specific geometry.

Fig 4-1 gear

Application

Being important parts of a machine, gears have immense usage within various industries, including automotive industries, coal plants industry, steel plants industry, paper industry, mining industry etc. In these industries, they behold a wide area of application. They are used as conveyors, elevators, kilns, separators, cranes and lubrication systems.

Gears are used for two basic purposes, increase or decrease of rotation speed and increase or decrease of power or torque. Torque is a measure of a force to produce torsion and rotation about an axis. To increase speed and reduce torque, a large drive gear is coupled to a smaller driven gear. To reduce speed and increase torque, a small gear turning a larger gear is used. They are also used for enhancement for positioning systems.

Gear geometry

The essential features of a gear mesh are:

Center distance: The distance between the centers of two pitch circles.

Pitch diameters: The tangent to two basic circles is the line of contact in gear vernacular. Where this line crosses the line of center establishes the pitch. The ratio of pitch diameters gives the velocity ratio.

Pitch: It is a measure of tooth spacing along the pitch circle.

Number of teeth

Pressure angle of the contacting involutes: The angle between the line of force between meshing teeth and the tangent to the pitch circle at the point of mesh.

NEW WORDS AND EXPRESSIONS

gear *n.*	齿轮
mesh *v.*	啮合
toothed *adj.*	有……齿的，锯齿状的
transmit *v.*	传递，传送
automotive transmission	汽车变速器
spur gear	直齿圆柱齿轮
rack *n.*	齿条
worm gear	蜗轮

center distance	中心距
pitch circle	分度圆
number of teeth	齿数
pressure angle	压力角

Lesson 5 Introduction to Cams

A cam is a mechanical component of a machine that is used to transmit motion to another component, called the follower, through a prescribed motion program by direct contact.

A cam mechanism consists of three elements: the cam, the follower (or follower system), and the frame. The follower is in direct contact with the cam. The cam may be of various shapes. The follower system includes all of the elements to which motion is imparted by the cam. This may be connected directly to the follower, or connected through linkages and gearing. The frame of the machine supports the bearing surfaces for the cam and for the follower.

Uses for cams:

The cam mechanism is a versatile one. It can be designed to produce almost unlimited types of motioning the follower. It is used to transform a rotary motion into oscillating motion. On certain occasions, it is also used to transform one oscillating motion into a different oscillating motion.

Cams are used in a wide variety of automatic machines and instruments. Typical examples of their usage include textile machineries, computers, printing presses, food processing machines, internal combustion engines, and countless other automatic machines, control systems and devices. The cam mechanism is indeed a very important component in modern mechanization.

The most well known use of cams is in car engines. The cam operated valve system (fig 5-1) can be found in modern car engines and incorporates a number of cams and the valves are opened by cams.

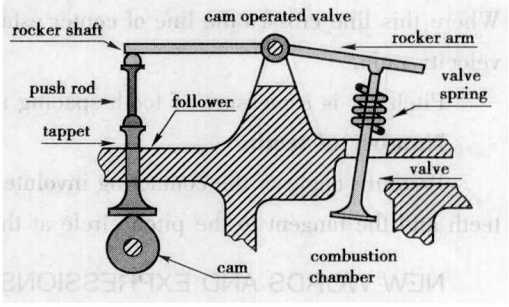


Fig 5-1 cam-valve mechanism

Cams can be conveniently classified into two main groups:

Group a: Cams that impart motion to the follower in a plane in line with the axis of rotation of the cam (as does a cylindrical cam).

Group b: Cams that impart motion to the follower in a plane at 90 degrees to the axis of rotation, as with face or edge cams. Most cams fall into this category.

The cam, as a means of producing a given type of motion, is simple and reasonable to design, provided the simple principles are understood. Another advantage is that, generally, a cam can easily be changed or modified to allow a change of motion; without interfering with the remainder of the mechanism.

NEW WORDS AND EXPRESSIONS

cam *n.*	凸轮
follower *n.*	从动件
frame *n.*	框架,机架
versatile *adj.*	通用的，万能的
internal combustion engine	内燃机
valve system	配气机构
impart *v.*	给予,传授
push rod	推杆
rocker arm	摇臂
petrol oil pump	汽油泵
plane *n.*	平面
interfere *v.*	干涉，干预

Lesson 6 Introduction to Springs

A spring (fig 6-1) is a common load-sensitive, energy-storing device. It has an ability to tolerate large deflections without failure and to recover its initial size and shape when loads are removed. Thus it can change mechanical energy into deformation energy and can also change deformation energy into mechanical energy. Springs have a wide use in many kinds of machines and many instruments.

In fact, common springs have the following functions:

(1) Even out shocks and absorb vibration. (e. g. springs of suspension in a vehicle);

(2) Stor e and release energy (e. g. mainspring in clocks and watches);

(3) Measure load (e. g. spring balance);

(4) Control motion (e. g. springs in relief valves).

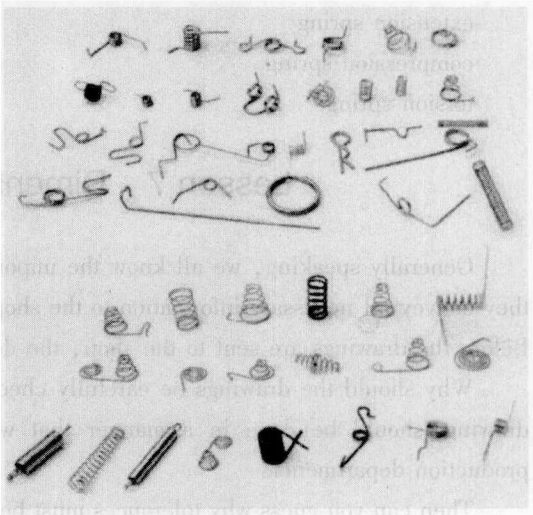


Fig 6-1 spring

Springs can be classified in different ways. According to different materials, springs can be divided into metal springs and nonmetal springs. According to different shapes, they can be named as helical springs, disc springs, circular springs, plate springs and so on. According to different load bearing properties, springs can be defined as extension springs, compression springs, torsion springs and bending springs.

The materials of springs should have higher yield strength and fatigue strength, enough impact toughness and good heat treatment properties. The common materials for springs are: high quality carbon steel, alloy steels, stainless steels, copper alloys, rubbers and plastics.

Generally speaking, if a solid body recovers its original size and shape after deformed, it is said to be elastic. And if the deflection of an elastic body is proportional to the load, we can say, the body is linearly elastic and to satisfy Hooke's law (formula 6-1).

$$F = k \cdot x \qquad \text{(Formula 6-1)}$$

From the formula 6-1, we can get the conclusion that if the load is doubled the deflection is doubled.

NEW WORDS AND EXPRESSIONS

spring *n.*	弹簧
load-sensitive	负载敏感的
energy-storing	储能的
deflection *n.*	挠度,变形,偏转
mechanical energy	机械能
deformation energy	变形能
even out	使平坦
helical spring	螺旋弹簧
disc spring	蝶形弹簧
plate spring	板簧
extension spring	拉伸弹簧
compression spring	压缩弹簧
torsion spring	扭簧

Lesson 7 Dimensions and Tolerances

Generally speaking, we all know the importance of the assembly and detail drawings. Because they convey all necessary information to the shop men before construction or manufacture can begin. Before the drawings are sent to the shop, the designer is often called upon to check the drawings.

Why should the drawings be carefully checked? Can you guess? Yes, the dimensioning of the drawings should be done in a manner that will be most convenient and understandable to the production departments.

Then can you guess why tolerances must be placed on the dimensions of drawings? We use them to limit the permissible variations in size because it is impossible to manufacture part exactly to a given dimension.

In dimensioning a drawing, the numbers placed in the dimension lines represent dimension that are only approximate and do not represent any degree of accuracy. To specify a degree of accuracy,