高等学校试用教材

建筑类专业英语

暖通与燃气 （第一册）

English in Architecture and Construction

赵三元 闫岫峰 主编

中国建筑工业出版社

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王　鸣　马立山

王建华　张素宁　编

杨印芳　主审

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本书按国家教委颁发的《大学英语专业阅读阶段的教学基本要求》规定组织编写的专业英语教材。本册内容包括工程热力学、流体力学、传热学、燃气概况等。全书安排16个单元，每单元除正课文外，还配有两篇阅读材料，均配有必要的注释。正课文还配有词汇表和练习，书后配有总词汇表、参考译文和练习答案。本书供本专业学生三年级上半学期使用，也可供有关专业人员自学英语参考。

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前　言

经过几十年的探索，外语教学界许多人认为，工科院校外语教学的主要目的应该是：“使学生能够利用外语这个工具，通过阅读去获取国外的与本专业有关的科技信息。”这既是我们建设有中国特色的社会主义的客观需要，也是在当前条件下工科院校外语教学可能完成的最高目标。事实上，教学大纲规定要使学生具有“较强”的阅读能力，而对其他方面的能力只有“一般”要求，就是这个意思。

大学本科的一、二年级，为外语教学的基础阶段。就英语来说，这个阶段要求掌握的词汇量为2400个（去掉遗忘，平均每个课时10个单词）。加上中学阶段已经学会的1600个单词，基础阶段结束时应掌握的词汇量为4000个。仅仅掌握4000个单词，能否看懂专业英文书刊呢？还不能。据统计，掌握4000个单词，阅读一般的英文科技文献，生词量仍将有6%左右，即平均每百词有六个生词，还不能自由阅读。国外的外语教学专家认为，生词量在3%以下，才能不借助词典，自由阅读。此时可以通过上下文的联系，把不认识的生词猜出来，那么，怎么样才能把6%的生词量降低到3%以下呢？自然，需要让学生增加一部分词汇积累。问题是，要增加多少单词？要增加哪一些单词？统计资料表明，在每一个专业的科技文献中，本专业最常用的科技术语大约只有几百个，而且它们在文献中重复出现的频率很高。因此，在已经掌握4000个单词的基础上，在专业阅读阶段中，有针对性地通过大量阅读，扩充大约1000个与本专业密切有关的科技词汇，便可以逐步达到自由阅读本专业科技文献的目的。

早在八十年代中期，建设部系统院校外语教学研究会就组织编写了一套《土木建筑系列英语》，分八个专业，共12册。每个专业可选读其中的3、4册。那套教材在有关院校相应的专业使用多年，学生和任课教师反映良好。但是，根据当时的情况，那套教材定的起点较低（1000词起点），已不适合今天学生的情况。为此，在得到建设部人事教育劳动司的大力支持，并征得五个相关专业教学指导委员会同意之后，由建设部系统十几所院校一百余名外语教师和专业课教师按照统一的编写规划和要求，编写了这一套《建筑类专业英语》教材。

《建筑类专业英语》是根据国家教委颁发的《大学英语专业阅读阶段教学基本要求》编写的专业阅读教材，按照建筑类院校共同设置的五个较大的专业类别对口编写。五个专业类别为：建筑学与城市规划；建筑工程（即工业与民用建筑）；给水排水与环境保护；暖通、空调与燃气；建筑管理与财务会计。每个专业类别分别编写三册专业英语阅读教材，供该专业类别的学生在修完基础阶段英语后，在第五至第七学期专业阅读阶段使用，每学期一册。

上述五种专业英语教材语言规范，题材广泛，覆盖相关专业各自的主要内容：包括专业基础课、专业主干课及主要专业选修课，语言材料的难易度切合学生的实际水平；词汇

以大学英语“通用词汇表”的4000个单词为起点，每个专业类别的三册书将增加1000～1200个阅读本专业必需掌握的词汇。本教材重视语言技能训练，突出对阅读、翻译和写作能力的培养，以求达到《大学英语专业阅读阶段教学基本要求》所提出的教学目标：“通过指导学生阅读有关专业的英语书刊和文献，使他们进一步提高阅读和翻译科技资料的能力，并能以英语为工具获取专业所需的信息。”

《建筑类专业英语》每册16个单元，每个单元一篇正课文（TEXT），两篇副课文（Reading Material A & B），每个单元平均2000个词，三册48个单元，总共约有十万个词，相当于原版书三百多页。要培养较强的阅读能力，读十万个词的文献，是起码的要求。如果专业课教师在第六和第七学期，在学生通过学习本教材已经掌握了数百个专业科技词汇的基础上，配合专业课程的学习，再指定学生看一部分相应的专业英语科技文献，那将会既促进专业课的学习，又提高英语阅读能力，实为两得之举。

本教材不仅适用于在校学生，对于有志提高专业英语阅读能力的建筑行业广大在职工程技术人员，也是一套适用的自学教材。

建设部人事教育劳动司高教处和中国建设教育协会对这套教材的编写自始至终给予关注和支持；中国建筑工业出版社第五编辑室密切配合，参与从制定编写方案到审稿各个阶段的重要会议，给了我们很多帮助。在编写过程中，各参编学校相关专业的许多专家、教授对材料的选取、译文的审定都提出了许多宝贵意见，谨此致谢。

《建筑类专业英语》是我们编写对口专业阅读教材的又一次尝试，由于编写者水平及经验有限，教材中不妥之处在所难免，敬请广大读者批评指正。

《建筑类专业英语》
编审委员会

Contents

UNIT ONE

Text Basic Concepts and Definitions

[1] Most applications of thermodynamics require that the system and its surroundings be defined. A thermodynamic system is defined as a region in space or a quantity of matter bounded by a closed surface. The surroundings include everything external to the system, and the system is separated from the surroundings by the system boundaries. These boundaries can be either movable or fixed; either real or imaginary.

[2] Two master concepts operate in any thermodynamic system, energy and entropy. Entropy (s) measures the molecular disorder of a given system. The more shuffled a system is, the greater its entropy; conversely, an orderly or unmixed configuration is one of low entropy. ①

[3] Energy is the capacity for producing an effect, and can be categorized into either stored or transient forms. Stored forms of energy include:

thermal (internal) energy, u—the energy possessed by a system caused by the motion of the molecules and/or intermolecular forces②

potential energy, *P. E.* —the energy possessed by a system caused by the attractive forces existing between molecules, or the elevation of the system:

$$P.\ E.\ = mgz \tag{1.1}$$

where

m=mass

g=local acceleration of gravity

z=elevation above a horizontal reference plane

kinetic energy, *K. E.* —the energy possessed by a system caused by the velocity of the molecules:

$$K.\ E.\ = mv^2/2 \tag{1.2}$$

where

m=mass

v=velocity of the fluid streams crossing system boundaries

chemical energy, Ec—energy possessed by the system caused by the arrangement of atoms composing the molecules.

nuclear (atomic) energy, Ea—energy possessed by the system from the cohesive forces holding protons and neutrons together as the atom's nucleus. ③

[4] Transient energy forms include:

heat, Q —the mechanism that transfers energy across the boundary of systems with differing temperatures, always in the direction of the lower temperature. ④

work—the mechanism that transfers energy across the boundary of systems with differing pressures (or force of any kind), always in the direction of the lower pressure; if the total effect produced in the system can be reduced to the raising of a weight, then nothing but work has crossed the boundary. ⑤ Mechanical or shaft work, W, is the energy delivered or absorbed by a mechanism, such as a turbine, air compressor or internal combustion engine.

Flow work is energy carried into or transmitted across the system boundary because a pumping process occurs somewhere outside the system, causing fluid to enter the system. ⑥ It can be more easily understood as the work done by the fluid just outside the system on the adjacent fluid entering the system to force or push it into the system. ⑦ Flow work also occurs as fluid leaves the system.

$$\text{Flow Work (per unit mass)} = Pv \qquad (1.3)$$

where P is the pressure and v is the specific volume, or the volume displaced per unit mass.

[5] A property of a system is any observable characteristic of the system. The state of a system is defined by listing its properties. The most common thermodynamic properties are: temperature (T), pressure (P) and specific volume (v) or density (ρ). Additional thermodynamic properties include entropy, stored forms of energy and enthalpy.

Frequently, thermodynamic properties combine to form new properties. Enthalpy (h), a result of combining properties, is defined as :

$$h = u + Pv \qquad (1.4)$$

where

u=internal energy

p=pressure

v=specific volume

Each property in a given state has only one definite value, and any property always has the same value for a given state, regardless of how the substance arrived at that state.

[6] A process is a change in state that can be defined as any change in the properties of a system. A process is described by specifying the initial and final equilibrium states, the path (if identifiable) and the interactions that take place across system boundaries during the process. A cycle is a process, or more frequently, a series of processes wherein the initial and final states of the system are identical. Therefore, at the conclusion of a cycle all the properties have the same value they had at the beginning.

[7] A pure substance has a homogeneous and invariable chemical composition. It can exist in more than one phase, but the chemical composition is the same in all phases.

[8] If a substance exists as vapor at the saturation temperature, it is called saturated vapor. (Sometimes the term dry saturated vapor is used to emphasize that the quality is 100%). ⑧ When the vapor is at a temperature greater than the saturation temperature , it is superheated vapor. The pressure and temperature of superheated vapor are independent properties, since the temperature can increase while the pressure remains constant. Gases are highly superheated vapors.

New Words and Expressions

thermodynamics [ˈθəməudaiˈnæmiks]	*n.*	热力学
entropy [ˈentrəpi]	*n.*	熵（热力学函数）
shuffle [ˈʃʌfl]	*vt.*	搅乱，弄混
configuration * [kənˌfigjuˈreiʃən]	*n.*	构造，结构
categorize * [ˌkætigənaiz]	*v.*	把…分类
transient [trænziənt]	*a.*	（物）瞬变的
thermal * [θəːməl]	*a.*	热的
elevation * [ˌeliˈveiʃən]	*n.*	高度
acceleration * [ækˌseləˈreiʃən]	*n.*	（物）加速，加速度
kinetic [kaiˈnetik]	*a.*	动力（学）的，动力的
cohesive [kəuˈhiːsiv]	*a.*	内聚的
cohesive forces		内聚力
proton [ˈprəutɔn]	*n.*	质子
neutron [ˈnjuːtrɔn]	*n.*	中子
mechanism * [ˈmekənizəm]	*n.*	机械装置，机械结构
shaft * [ʃɑːft]	*n.*	轴
compressor [kəːmˈpresə]	*n.*	压缩机，压气机
combustion [kəmˈbʌstʃən]	*n.*	燃烧
adjacent * [əˈdʒeisənt]	*a.*	邻近的，因此相连的
specific volume		比容
displace [disˈpleis]	*vt*	排（水）
enthalpy [enˈθælpi]	*n.*	焓
equilibrium * [iːkwiˈlibriəm]	*n.*	平衡，均衡
homogeneous * [hɔˈmɔdʒinəs]	*a.*	均匀的
saturation [ˌsætʃəˈreiʃən]	*n.*	饱和（状态）
saturated [ˈsætʃəreitid]	*a.*	饱和

Notes

①The more shuffled... the greater...：这是“越……越……”句型。

②... the motion of the molecules and/or intermolecular forces：应理解为... the motion of the molecules and intermolecular forces 以及 the motion of the molecules or intermolecular forces.

③... energy possessed by... forces holding... together as the atom's nucleus.：possessed by... forces 过去分词短语作定语修饰 energy；holding ... as... 现在分词短语

作定语修饰 cohesive forces。

④... the mechanism that transfers... with..., always in the direction of the lower temperature:

句中 that 引起的定语从句修饰 mechanism; with 短语修饰 systems; always in the direction of... 短语修饰 transfers。

⑤... nothing but: 只有。

⑥... a pumping process occurs somewhere outside the system, causing fluid to enter the system:

causing... 现在分词短语作 a pumping process ... the system 的结果状语。

⑦... the work... on...: 对……做的功。

⑧quality: 本文译为干度。

Exercises

Reading Comprehension

Ⅰ. Match Column A with Column B according to the text.

A	B
1. A thermodynamic system	a. Energy possessed by the system from the cohesive forces holding protons and neutrons together as the atom's nucleus.
2. Entropy	b. Energy possessed by the system caused by the arrangement of atoms composing the molecules.
3. Energy	c. The energy possessed by a system caused by the velocity of the molecules.
4. Thermal (internal) energy	d. The energy possessed by a system caused by the attractive forces existing between molecules, or the elevation of the system
5. Potential energy	e. The energy possessed by a system caused by the motion of the molecules and/or intermolecular forces.
6. Kinetic Energy	f. The capacity for producing an effect.
7. Chemical energy	g. Measures the molecular disorder of a given system.
8. Nuclear (atomic) energy	h. a region in space or a quantity of matter bounded by a closed surface.

Ⅱ. Separate the two types of properties according to the text.

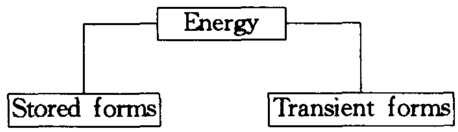
temperature, entropy, pressure, specific volume
stored forms of energy and enthalpy,

1. The most common thermodynamic properties are:

2. Additional thermodynamic properties include:

Ⅱ. Do the following exercises according to the text.

1. Skim through the text and complete the following table.



Stored forms	Transient forms
1) ________	1) ________
2) ________	2) ________
3) ________	3) ________
4) ________	
5) ________	

2. Give the definitions to the following terms:

1) Heat ________

2) Work ________

3) Mechanical or shaft work ________

4) Flow work ________

3. Fill in the blanks with the information given in the last three paragraphs:

1) What is a process?

(a) A process is a change in state ________
____
____

(b) A process is described by ________
____
____

2) What are the saturated vapor and superheated vapor?

(a) If a substance ________ it is called ________.

(b) When the vapor is ________ it is ________.

Vocabulary

Ⅰ. Find words in the text which mean almost the same as the following.

1. Para. 2: being mixed in a mass confusion (________)
2. Para. 2: not lasting or staying long (________)
3. Para. 3: of or relating to the motion of material bodies and the forces and energy associated therewith (________)

4. Para. 4: the process of burning (________________)

5. Para. 7: the state of being saturated (________________)

Now use the words you have found to complete the following sentences. Change the forms if necessary.

6. The more __________ a system is, the greater difficulty it will have in its operation.

7. We have several kinds of engines and internal __________ engine isone of them.

8. A substance can exist as vapor at the __________ temperature.

9. __________ energy is one kind of stored forms of energy.

10. Heat, work, mechanical or shaft work and flow work are includedin the __________ energy forms.

Ⅱ. Fill in the blanks with the words given below. Change the forms if necessary

elevation, categorize, acceleration, adjacent, homogeneous

1. The house is at an __________ of 2000 meters.

2. The __________ of decay is caused by enzymes.

3. They live in the __________ rooms in the same building.

4. The students are helping the librarians to __________ all the books into several kinds.

5. A __________ and invariable chemical composition is indispensable in a pure substance.

Reading Material A

Thermodynamic Systems

In the engineering world, objects normally are not isolated from one another. In most engineering problems many objects enter into a given problem. Some of these objects, all of these objects, or even additional ones may enter into a second problem. The nature of a problem and its solution are dependent on which objects are under consideration. Thus, it is necessary to specify which objects are under consideration in a particular situation. In thermodynamics this is done either by placing an imaginary envelope around the objects under consideration or by using an actual envelope if such exists. ① The term system refers to everything lying inside the envelope. The envelope, real or imaginary, is referred to as the boundaries of the system. It is essential that the boundaries of the system be specified very carefully. For example, when one is dealing with a gas in a cylinder where the boundaries are located on the outside of the cylinder, the system includes both the cylinder and its contained gas. ② On the other hand, when the boundaries are placed at the inner face of the cylinder , the system consists solely of the gas itself.

When the boundaries of a system are such that it cannot exchange matter with the surroundings, the system is said to be a closed system (see Fig. 1-1*a*). ③ The system, however, may exchange energy in the form of heat or work with the surroundings. The boundaries of a closed system may be rigid or may expand or contract, but the mass of a closed system cannot change. Hence, the term control mass sometimes is used for this type of system. When the energy crossing the boundaries of a closed system is zero or substantially so, the system may be treated as an isolated system④ (Fig. 1-1*b*).

In most engineering problems, matter, generally a fluid, crosses the boundaries of a system in one or more places. Such a system is known as an open system (see Fig. 1-1*c*). The boundaries of an open system are so placed that their location does not change with time. Thus, the boundaries enclose a fixed volume, commonly known as the control volume.

Sometimes a system may be a closed system at one moment and an open one the next. For example, consider the cylinder of an internal combustion engine with the boundaries at the inner walls. With the valves closed, the system is a closed one. However, with either or both of the valves open, the system becomes an open system. ⑤

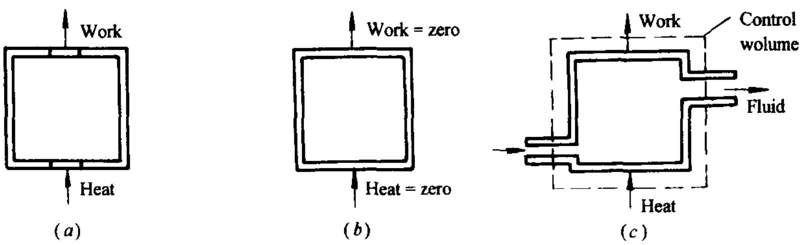


Fig. 1-1 Types of systems

(*a*) Closed system (*b*) Isolated system (*c*) Open system

Frequently the total system to be considered may be large and complicated. The system may be broken down into component parts and an analysis of the component parts made. Then the performance of the entire system can be determined by the summation of the performance of the individual component systems. For example, consider the liquid-vapor part of a steam power plant as an entire system. ⑥ This system, which is closed, contains the steam generator, the steam turbine, the steam condenser, the feed-water pumps, and the feed-water heaters. Any or all of these units may be considered separately by throwing a boundary around them. ⑦ Since a fluid enters and leaves each of these smaller systems, each one is an open system and must be analyzed as such.

Notes

①在热力学中，这点是通过下列两种方法中的任何一种来实现的，即在研究的物体周围设置假想的封闭面或者使用实际封闭面，如果这样的实际封闭面存在的话。

②例如：当我们研究气缸内的气体时，如果边界位于气缸之外，则该系统包括气缸和气缸内的气体。

③当系统的边界使得系统不能与其环境交换物质时，则该系统称为闭口系统。

such that：（是）这样（以致）。

④当越过闭口系统边界的能量是零或者实质是这样的时候，这种系统就可以按孤立（隔离）系统对待。
⑤如果阀门关闭，系统就是闭口系统。但是，如果两个阀门都关闭或者其中一个关闭，该系统就变成开口系统。
⑥例如：把蒸汽动力厂的液一汽部分作为一个完整系统来考虑。
⑦任何一个或所有这些装置都可以通过在它们周围加一个边界而分别予以考虑。

Reading Material B

Pressure

Pressure is defined as the force acting on a unit area. When a force is exerted on a fluid, this force is transmitted throughout the fluid. If the fluid is stationary, the pressure within the fluid is uniform throughout the fluid, if we neglect the force of gravity action on the fluid. The fluid exerts a pressure on its containing walls which, in turn, exert the same pressure on the fluid.①

In the SI system , pressure is expressed in newtons per square meter (N/m^2).② This unit of pressure is sometimes called the pascal (Pa). Expressed in fundamental SI units, the dimensions of the pascal $kg/m\text{-}s^2$.③ In the English system, pressures are expressed generally in pounds per square inch (psi).

Thermodynamically speaking, there is only one kind of pressure and that is absolute pressure. Although there are devices available to measure absolute pressures, most pressure measuring devices measure pressure differences.

A very common pressure measuring device is the Bourdon-tube type of pressure gage.④ Fundamentally, this gage consists of a coiled elliptical tube that is fixed at one end and free to move at the other end. The pressure to be measured is transmitted to the inside of the tube. There will be movement of the free end of the tube when the pressure within the tube differs from that outside the tube. The movement of the tube is transmitted to the needle of the gage. Because the pressure on the outside of the tube is atmospheric, the reading on the gage is the pressure above or below that of the atmosphere. In general, then, gage pressure is defined as the pressure above or below that of the atmosphere.

Another type of pressure device is the manometer. The U-tube type of manometer is illustrated in Fig. 1-2 . Here the fluid pressure to be measured is balanced against the weight of a column of a liquid. Liquids commonly used for this purpose are water, mercury, and special manometer oil. A knowledge of the specific weight, or the weight per unit volume, of the fluid and the height of the column that balances the pressure permits the determination of the pressure. Thus, the product of the specific weight in pounds per cubic inch and the column height in inches equals the pressure in pounds per square inch.⑤ In general terms, since the force exerted by liquid, $F=W=wV=wAz$, then

$$p=\frac{force}{area}=wz \tag{1.5}$$

where p=pressure

w=specific weight

z=column height

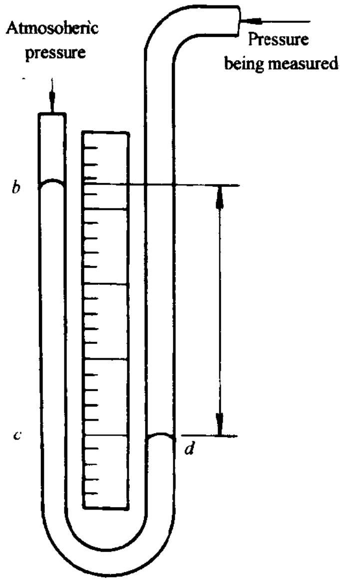


Fig. 1-2 U-tube type of manometer

In Eq. 1. 5, the units of pressure will be fixed by the selection of the units of specific weight and the column height.

The atmospheric pressure must be added to the gage pressure to obtain the true or absolute pressure. Barometers generally are used to determine the atmospheric pressure. Hence, atmospheric pressure frequently is referred to as the barometric pressure. Standard atmospheric pressure (i. e., pressure of the standard atmosphere) is defined as being equivalent to a mercury column 760 mm high, where the mercury has a temperature of 0℃. ⑥ This is equivalent to a pressure of 14. 6960 psi.

When the pressure is less than atmospheric, a vacuum is said to exist. The magnitude of the vacuum denotes how much the pressure is below that of the atmosphere. Vacuum generally is expressed as the height of a mercury column.

Notes

①流体对容器壁施加压力，而容器壁则又对流体施加等压。

②SI：国际单位制。

③该压力单位有时称为帕斯卡（帕），用基本的国际单位表示，帕斯卡的因次为千克/米·秒^2。

④the Bourdon-tube type of pressure gage：弹簧管压力计，布尔登（管式）压力计。

⑤这样，比重（磅/英寸^3）和柱高（英寸）的乘积就等于压力（磅/英寸^2）。

⑥标准大气压（即标准大气的压力）就是 760 毫米水银柱高，这儿水银是 0℃。

UNIT TWO

Text Application of the Principles of Thermodynamics to Steady-Flow Components of Engineering Systems

[1] Many complex engineering systems operate with steady or periodic flow which simplifies the thermodynamic analysis. The systems are constructed by interconnecting steady-flow components which are grouped into four classes according to function: (1) shaft work machines, (2) nozzles and diffusers, (3) throttles, and (4) heat exchangers. An understanding of the behavior of these components is the key to understanding the thermodynamic plants discussed in the next chapter. ①

[2] Our objective in this chapter is to determine the thermodynamic behavior of the components of each class by applying the principles of thermodynamics to a control volume containing the component. This approach yields the "black box" characteristics of the component that must be known in order to evaluate the performance of the complete system. ② This does not mean that the principles of thermodynamics do not apply or are not useful in determining the detailed internal processes of the component. On the contrary, in designing such a component, thorough consideration must be given to the complex internal processes; however, the analysis of these internal processes is outside the scope of our present objective.

[3] The analysis of this chapter is based on the equations for steady flow for the control volume with one inlet port and one exit port . In addition it will be useful to consider a control volume of infinitesimal extent in the direction of flow. ③ The fluid experiences an infinitesimal change of state between inlet and outlet in response to infinitesimal rates of heat transfer and shear work transfer. Thus we can get differential relations:

$$\frac{\delta \dot{Q}}{\dot{m}} - \frac{\delta \dot{Q}_{\text{shear}}}{\dot{m}} = dh + vdv - gdz$$

[4] The analysis will be illustrated by application to the flow of an incompressible fluid, the flow of an ideal gas, and to the flow of a pure substance in two phase states. These cases illustrate the basic behavior of each of four classes of steady-flow components.

[5] The first class of components is comprised of machines which change the state of a stream by positive or negative shaft work transfer. Machines with positive shaft work transfer are commonly called turbines, reciprocating engines, expanders, or fluid motors, depending upon the application and the method of developing the pressure forces that produce the shaft work transfer. Machines with negative shaft work transfer are commonly called compressors, pumps, or fans depending upon the application.

[6] The operation of a shaft work machine does not depend upon the attainment of thermal equilibrium between the flowing fluid and the walls of the apparatus; consequently, the rate of work transfer is not limited by the relatively slow thermal conduction process. Rather, the