专业英语阅读丛书

电气自动化专业英语

（修订版）

ACADEMIC ENGLISH OF ELECTRIC AUTOMATION

李久胜 马洪飞 陈宏钧 刘汉奎 编

哈尔滨工业大学出版社

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内 容 提 要

本书分电子技术、电机控制技术、计算机控制技术、自动控制系统四部分，共十五章，每章后配有以专业术语为主的词汇表。本书从大学高年级学生科技英语阅读和写作的需要出发，选取的专业技术类文章覆盖了电气自动化领域的基础内容。

本书既可作为高等院校电气自动化类各专业的英语教材，也可作为有关工程技术人员从事英文科技阅读和写作的参考书。

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Dianqi Zidonghua Zhuanye Yingyu

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再版前言

《电气自动化专业英语》(第1版)自1999年5月出版发行以来,由于其专业知识覆盖面较广、所选文章有代表性,得到了许多工科院校相关专业的认同和支持,不到一年时间,第一次印刷的5 000册就销售待尽,这对于本书的四位作者无疑是极大的鼓励和鞭策。

为了不辜负读者的厚爱,同时本着不断完善的宗旨,本次再版时,我们对第1版做了系统的修订和补充,并在每章后增加了重点、难点句子的译文,以便于读者自学。

由于我们的能力有限,经过修订后,书中仍会存在缺点和不足,欢迎读者批评指正。

编　者

2000年5月 于哈尔滨

前　　言

随着国际交流的日益增强，对于大学生英语能力的要求不断提高，阅读和撰写英文科技文章已成为在科学技术领域参与国际交流的重要手段。由于科技英语的表达方式、词汇范畴与公共英语差异较大，所以专业英语训练是大学高年级学生继公共英语课程之后的一个重要补充和提高。为此，编者根据培养高素质跨世纪人才对专业英语教学的要求、参考大量国外当代的教材、专著和教学参考书、结合自己的教学体会的基础上，编写了这本适合于电气自动化类各专业的英语教材。本书可作为高等院校电气自动化类各专业的英语教材(参考学时 60)，也可供工程技术人员阅读参考。本书从实用角度出发，结合电气自动化类各专业所学的内容，选取了该专业领域的大量科技文章，表述规范、专业词汇丰富、内容权威、结构完整，各部分后均配有词汇和短语。全书共分四个部分：

第一部分(1～4 章)电子技术。包括电子测量、模拟和数字电子技术及电力电子技术。

第二部分(5～8 章)电机控制技术。包括电机原理和结构、电机的基本控制系统及运动控制传感器。

第三部分(9～11 章)计算机控制技术。包括计算机网络及可编程控制器的基础知识。

第四部分(12～15 章)自动控制系统。包括电力分配技术、自动控制原理及电力拖动自动控制系统。

本书由哈尔滨工业大学工业自动化教研室的四位教师联合编写，1～4 章由李久胜编写，5～8 章由马洪飞编写，9～11 章由陈宏钧编写，12～15 章由刘汉奎编写。在编写过程中得到刘金琪老师的大力协助，并提出了许多宝贵意见，在此表示感谢。

由于编者水平和经验有限，书中难免存在不足和疏漏之处，敬请读者批评指正。

编　者

1999 年 4 月　于哈尔滨

CONTENTS

PART Ⅳ AUTOMATIC CONTROL SYSTEMS

PART Ⅰ ELECTRONICS

1 Electrical Measuring Instruments

Electrical personnel use many different types of measuring instruments. Some jobs require very accurate measurements while other jobs need only rough estimates. Some instruments are used solely to determine whether or not a circuit is complete. The most common measuring and testing instruments are voltage testers, voltmeters, ammeters, ohmmeters, continuity testers, megohmmeters, wattmeters, and watt-hour meters.

All meters used for measuring electrical values are basically current meters. They measure or compare the values of current flowing through them. The meters are calibrated and the scale is designed to read the value of the desired unit.

1.1 Safety Precaution

Correct meter connections are very important for the safety precaution of the user and for proper maintenance of the meters. A basic knowledge of the construction and operation of meters will aid the user in making proper connections and maintaining them in safe working order.

Many instruments are designed to be used on DC or AC only, while others can be used interchangeably. Note: It is very important to use each meter only with the type of current for which the meter is designed. Using a meter with an incorrect type of current can result in damage to the meter and may cause injury to the user.

Some meters are constructed to measure very low values. Other meters can measure extremely high values.

CAUTION: Never allow a meter to exceed its rated maximum limit. The importance of never allowing the actual value to exceed the maximum value indicated on the meter can not be overemphasized. Exceeding maximum values can damage the indicating needle, interfere with proper calibration, and in some instances may cause the meter to explode, resulting in injury to the user. Some meters are equipped with over correct protection. However, a current many times greater than the instrument's design limit may still be hazardous.

1.2 Basic Meter Construction and Operation

Many meters operate on the principle of electromagnetic interaction. This interaction is caused by an electric current flowing through a conductor which is placed between the poles of a permanent magnet. This type of meter is especially suitable for direct current.

Whenever an electric current flows through a conductor a magnetic force is developed around the conductor. The magnetic force caused by the electric current reacts with the force of the permanent magnet. This causes the indicating needle to move. The larger the amount of current, the farther the needle will move.

The conductor is formed into coil, which is placed on a pivot between the poles of the permanent magnet. The coil is connected to the terminals of the instrument through two spiral springs. These springs supply a reacting force proportional to the deflection. When no current is flowing, the springs cause the needle to return to zero.

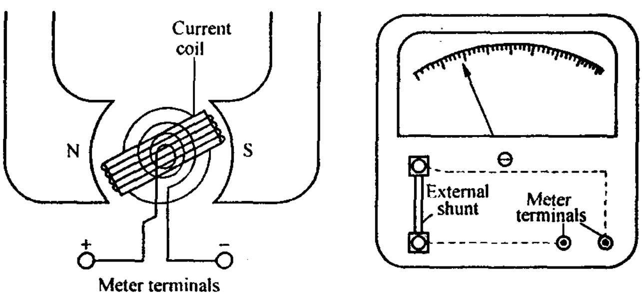
The meter scale is designed to indicate the amount of current being measured. The movement of the coil (and thus the movement of the indicating needle) is proportional to the amount of current flowing in the coil.

If it is necessary to measure larger currents than the coil can safely carry, a bypass circuit, or shunt, is included. The shunt many be contained within the meter housing or connected externally.

Example 1

A meter is constructed to measure 10 A on a maximum scale. The coil can safely carry 0.001 A. The shunt must be designed to carry 9.999 A. The meter is designed to indicate 10 A when 0.001 A flows in the coil.

Fig. 1. 1 (a) illustrates a permanent-magnet meter. Fig. 1. 1 (b) show an external shunt connected across the meter terminals. The permanent-magnet meter can be used as an ammeter or a voltmeter. When the scale is designed to indicate current and the internal resistance is kept to a minimum, the meter functions as an ammeter. When the scale is designed to indicate voltage, the internal resistance will be relatively high, depending upon the value of voltage for which the meter is designed. Note: Regardless of the design, the distance the needle moves is determined by the amount of current flowing in the coil.



(a) Permanent-magnet meter (b) Permanent-magnet meter with external shunt

Fig. 1.1

A slight change must be made in the design in order to use this type of meter on AC. A rectifier is a device which changes AC to DC. It must be incorporated into the meter and the scale must be drawn to indicate the correct value of AC voltage. Rectifier-type AC meters cannot be used on DC and are generally designed as voltage meters.

The electrodynamometer, Fig. 1.2 is another design for both ammeters and voltmeters that can be used on alternating current. This instrument consists of two stationary coils and one movable coil. The three coils are connected in series with each other through two spiral springs. The spring also support the movable coil. When current flows through the coils the movable coil moves in a clockwise direction.

In the electrodynamometer. The scale is not divided uniformly, as it is in permanent magnet-type meters. The force on the movable coil varies with the square of the current flowing through the coils. This requires that the divisions near the beginning of the scale be made closer together than those near end. The greater the distance between the divisions, the more accurately one can read the meter. It is important to strive for an accurate reading.

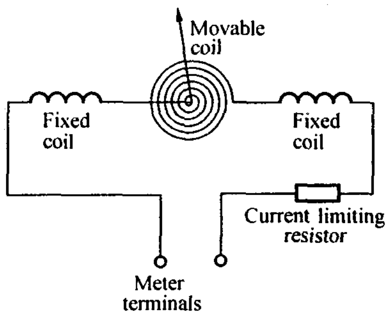


Fig. 1.2 Voltmeter-type electrodynamometer instrument

The moving-vane meter is another type of construction for meters. Current flowing in the coil causes two iron strips (the vanes) to become magnetized. One vane is movable; the other is stationary. The magnetic reaction between the two vanes causes the movable one to turn. The amount of movement depends upon the value of current flowing in the coil.

CAUTION: All of the instruments described depend upon magnetism for their operation, so it is important that they not be placed near other magnets. The magnetic force from another magnet may damage the meter and/or cause incorrect measurements.

1.3 Use of Measuring Instrument

A voltmeter is designed to measure the electrical pressure applied to a circuit and/or the voltage drop across a component. Voltmeters must always be connected in parallel with the circuit or the component being measured.

1.3.1 Voltage Testers

The AC-DC voltage tester is a rather crude but useful instrument for the electrician. This instrument is designed to indicate approximate values of voltage. The more common types indicate the following values of voltage: AC, 110, 220, 440, and 550 V; DC, 125, 250, and 600 V. Many of these instruments will also indicate the "polarity" of DC; i.e., which conductor of the circuit is positively or negatively charged.

The voltage tester is used to check common voltages, to identify the grounded conductor, to check for blown fuses, and to distinguish between AC and DC. The voltage tester is small and rugged, making it easier to carry and store than the average voltmeter. Fig. 1.3 and 1.4 depict methods for testing fuses with a voltage tester.

To determine which conductor of a circuit or a system is grounded, connect the tester between one conductor and a well established ground. If the tester indicates a voltage, the conductor is not grounded. Continue this procedure with each conductor until zero voltage is indicated (see Fig. 1.5).

To determine the approximate voltage between any two conductors, connect the tester between the two conductors.

CAUTION: Always read and follow the instructions that are sup-

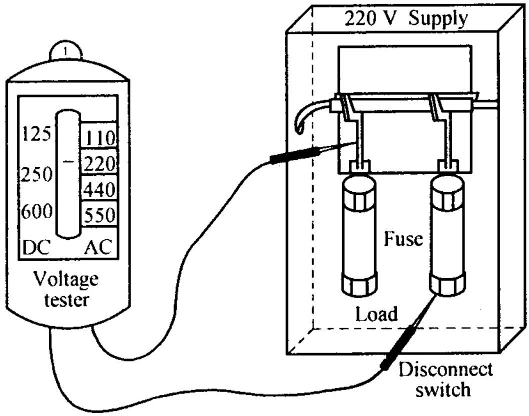


Fig.1.3 Testing cartridge fuses with a voltage tester. The tester indicates 220 V AC. The right-hand fuse is good. If the fuse is blown, the tester will indicate zero voltage

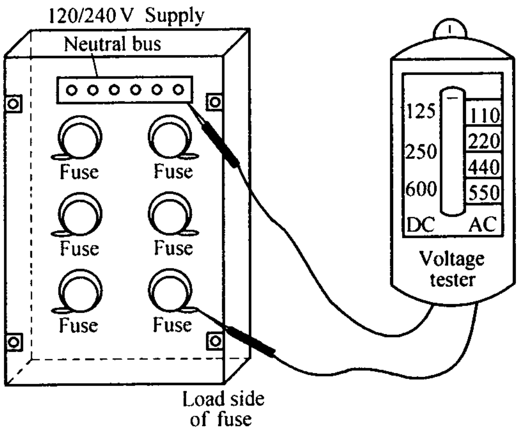


Fig.1.4 Testing plug fuses with a voltage tester. Tester value of zero volt indicates that the fuse is blown

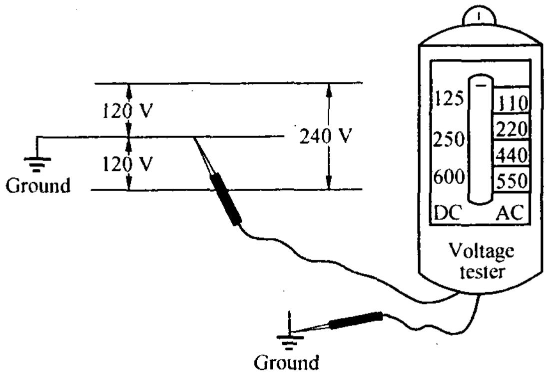


Fig. 1.5 Testing to locate the grounded conductor. If the tester indicates zero, the conductor is grounded

plied with the voltage tester.

1.3.2 Voltmeters

The voltmeter is a much more accurate measurement than the voltage tester. Because voltmeters are connected in parallel with the circuit or the component being considered, it is necessary that they have relatively high resistance. The internal resistance keeps the current through the meter to a minimum. The lower the value of current through the meter, the less effect it has on the electrical characteristics of the circuit.

The sensitivity (and therefore the accuracy) of the meter is stated in ohms per volt (Ω/V). The higher the ohms per volt, the better the quality of the meter. High values of ohms per volt minimize any change in circuit characteristics.

The average meter used by the electrician is generally between 95 percent and 98 percent accurate. This range of accuracy is satisfactory for most applications. It is very important, however, that the electrical worker strive to obtain the most accurate reading possible. An accurate reading can be obtained by standing directly in front of the meter face and looking directly at it. If the meter has a mirror behind the scale, adjust the angle of sight until there is no reflection of the indicating needle in the mirror. For extreme accuracy, a digital meter may be used.

Voltmeters can be used for the same applications as voltage testers. Voltmeters are much more accurate than voltage testers. Therefore, much more information can be obtained. For example, if the supply voltage to a building is slightly below normal, the voltmeter can indicate this problem. The voltmeter can also be used to determine the amount of voltage drop on feeder and branch circuit conductors.

Voltmeters sometimes have more than one scale. It is very important to select the scale that will provide the most accurate measurement. A range selector switch is provided for this purpose. Note: It is advisable to begin with a high scale and work down to the lowest scale so as not to exceed the range limit of any scale. Setting the selector switch on the lowest usable scale will provide the most accurate reading.

Before using the meter, check to be sure that the indicating needle is pointing to zero. An adjustment screw is provided just below the face of the meter. A very slight turn will cause the needle to move. The needle can be aligned with the zero line on the scale by turning the screw.

When using voltmeters on DC, it is very important to maintain proper polarity. Most DC power supplies and meters are color coded to indicate the polarity. Red indicates the positive terminal; black indicates the negative terminal. If the polarity of the circuit or component is unknown, touch the leads to the terminals while observing the indicating needle. If the indicating needle attempts to move backwards, the meter lead connections must be reversed.

CAUTION: Do not leave a meter connected with the polarity reversed.