工程英语对话 第二册

——电气工程

ENGINEERING BOOK 2

Electrical Engineering

英 汉 科 普 读 物

工 程 英 语 对 话
第 二 册
（电 气 工 程）

Engineering 2
(Electrical Engineering)

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内 容 提 要

《工程英语对话》是美国米兰公司出版的专业英语读物，全书分两册。第一册是土木、机械工程，共23课；第二册是电气工程和电子学，共19课。本书主要采用对话形式对土木、机械、电气工程作了通俗的介绍，并提供了大量基础专业词汇和基本句型。内容浅近易懂，文字生动活泼。书末附有课文的参考译文和总词汇表，可供大专院校学生和科技人员学习专业英语用。

第二册译文经李卫、夏培厚、李汉康同志审校。

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LESSON 1

ELECTRICAL FUNDAMENTALS

A. Dialogue

Mr. Adams: I'd like to talk to you about electricity, and I suppose the best place to start would be to ask: What is electricity?

Engineer: That's a hard one. We know a great deal about electricity, and we can make it do all sorts of things, but it's very difficult to define exactly what it is. One way might be to say that electricity consists of a quantity or stream of electrically-charged particles. These particles can be in the form of stored-up energy or they can be in motion.

Mr. Adams: I suppose electricity in motion would be called an electric current.

Engineer: That's right. We sometimes explain electrical effects by drawing a comparison with water moving in a closed system. A generator can then be thought of as a kind of pump that pushes the electricity

through a complete circuit. The electric wires are like the hollow centers of pipes, insulation corresponds to the pipes themselves, and switches are like valves.

Mr. Adams: What makes insulation act the way it does?

Engineer: Certain substances, for reasons that we don't always understand very well, block the flow of electric current. We call them insulators or non-conductors. Other substances—metals especially—are very good conductors.

Mr. Adams: Are there other similarities between electricity and the water system that you spoke about?

Engineer: Yes. Just as you can pump more water through bigger pipes, you can pump more electricity through bigger conductors. The mechanical resistance in pipes to the flow of water—in other words, the friction—corresponds to electrical resistance. The smaller the wire or the poorer the conductor, the more resistance you have. This electrical friction takes the form of heat.

Mr. Adams: In a water system there's a pump that creates pressure of, say, forty pounds per square inch. Can you speak of pressure in an electrical system?

Engineer: Yes, but we call it voltage. Even if no current is flowing, the voltage is there while the generator is operating. When the circuit is closed the current flows.

Mr. Adams: What are the main circuit elements?

Engineer: Basically, they are three: the resistor, the capacitor, and the inductor. They differ from each other in relation to the voltage and the current flowing through them.

Mr. Adams: Can you make that a little clearer?

Engineer: Yes. If the relationship involves simply the voltage and the current, the element is a resistor. In addition, if the relationship is linear—for example, if the voltage is five times the current—then we have a linear resistor, and its property is called resistance. Or, the relationship may involve the current

through the element and the time derivative of the voltage across it. In this case, the element is a capacitor, and its property is called capacitance. And an inductor is the element in which the voltage and the time derivative of the current are involved.

B. Terminology Practice

capacitance: the effect, or action, of a capacitor; the charge* of a capacitor divided by the voltage across it

    Its property is called capacitance.
    Some capacitance will be added to the circuit.
    This will cancel the effects of the capacitance.

capacitor: a device consisting of two conductors separated by a non-conductor; sometimes also called a condenser

    The element is a capacitor.
    The capacitors will have to be small.
    A bad capacitor is causing the trouble in your radio.

condenser: *see* capacitor
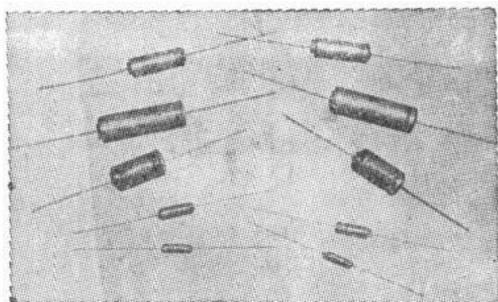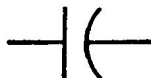
Photograph Philips, Eindhoven, The Netherlands

conductor: a substance that allows electric current to flow readily
    Silver is the best conductor.
    The most commonly used conductor is copper.
    Water is a fairly good conductor.

* for words in boldface, see the Glossary

current: as used here, electric current, the flow of electricity

They differ in relation to the voltage and the current.

The instrument will indicate the amount of current.

Current will cause heating.

derivative: the change of a quantity divided by the change of its variable as the change of the variable becomes extremely small

The relationship may involve the time derivative.

The derivative of the current must be considered.

You must first find the derivative of this quantity.

generator: as used here, a device producing electric power

How does a **d.c.** generator operate?

We need more than one generator here.

Mechanical power is supplied to the generator.

inductance: the property of a circuit that with a change of current results in a voltage

Its property is called inductance.

This device is designed to measure inductance.

The inductance in the circuit is increasing.

inductor: a device producing inductance

I can guess what an inductor is.

This inductor prevents the flow of high-frequency currents.

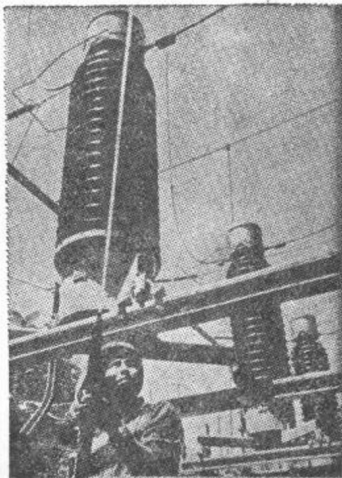You have a choice of several values for the inductor.

insulation: *see* insulator

insulator: a device or substance having in a high degree the property of insulation, that is, the tendency to block the flow of electric current

Porcelain is a good insulator.

Some substances are good insulators only when they are dry.

Air sometimes serves as an insulator.

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linear: as used here, the relationship in which one quantity is related to another by multiplication with a constant

    If the relationship is linear,-we have a linear resistor.

    Linear relationships make mathematical solutions easier.

    Under these circumstances, you can assume a linear relationship.

property: an ability to produce an effect or action

    Its property is called resistance.

    What is the property of this element?

    You have to consider the properties in relation to each other.

resistance: the property by which voltage is produced by the flow of current

    Its property is called resistance.

    This device will give a change of resistance.

    You must add resistance to prevent failure.

resistor: a device that has resistance

    The element is a resistor.

    This resistor will allow large currents.

    There are many types of resistors from which to choose.
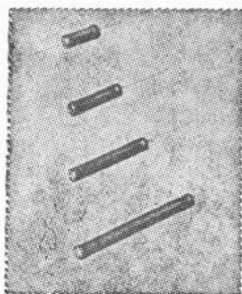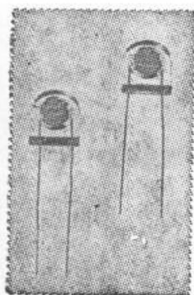
Photograph Philips, Eindhoven, The Netherlands

C. Check-Up

1. *Which of the following are elements and which are properties?*

    inductance   capacitance

    capacitor   inductor

    resistance   resistor

2. *What is the difference between current and voltage?*

Delco-Remy

LESSON 2

CIRCUIT ELEMENTS

A. Dialogue

Mr. Adams: Is there any energy involved with circuit elements?

Engineer: Oh yes, and it's very important, too. You see, voltage times charge gives energy, and voltage times current gives power.

Mr. Adams: I see. So when voltages, currents, and charges are present, there will also be energy or power.

Engineer: Exactly. However, each type of element has different energy properties.
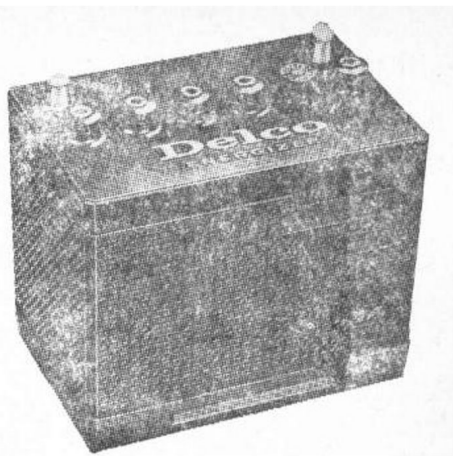
Mr. Adams: Could you give me more details on this?

Engineer: Yes. In a resistance, the energy is dissipated. It is changed to thermal energy. The actual power dissipated is proportional to the square of the voltage or the current. We sometimes use this property for electrical heating.

Mr. Adams: What happens in the case of a capacitance?

Engineer: Here things are a little more complicated. The property of capacitance appears with the existence of an electric field. Energy may be stored in this field, and then we speak of energy stored in the

	capacitor. This energy is proportional to the square of the voltage across the capacitor and may be returned to the circuit when the voltage or its charge becomes zero.
Mr. Adams:	I'd like to learn a little more about this energy storage, but first could you tell me about the inductance?
Engineer:	Here we have a similar situation. However, a magnetic field is involved now. The energy stored in this field is also the energy stored in the inductor. It is proportional to the square of the current through the inductor and is returned to the circuit when this current becomes zero.
Mr. Adams:	Now can you explain how the stored energy may be returned to a circuit?
Engineer:	Let me give you a simple example. Take a battery, a resistance, and a capacitance in series. As the current flows, energy from the battery goes to the resistance, where it is dissipated into heat, and to the capacitor, where it is stored. The capacitor, with its stored energy, may now be disconnected from the circuit and connected to another circuit, to which it may supply this energy. You may compare it with a spring like that on an automobile. Energy is stored when the spring is pushed in; the energy is released when the spring returns to its original position.
Mr. Adams:	Well, thanks a lot. I think I have a clearer idea now.

B. Terminology Practice

battery: a device which gives a constant voltage and is capable of supplying a constant current

Take a battery and a resistance in series.

The battery of this car needs replacing.

Is this radio operated by a battery?

charge: as used here, an electric charge, the quantity of electricity

Voltage times charge gives energy.

There will be a flow of charge through the wire.

The total amount of charge will remain constant.

dissipate: as used here, to change into heat with the result that available energy is diminished

The energy is dissipated.

You must provide a way for the energy to be dissipated.

The instrument will measure the power that is dissipated.

proportional: having a constant ratio

The power is proportional to the square of the voltage.

The charge is proportional to the voltage. ·

Are you sure that this quantity is proportional to the other?

series: as used here, a circuit connection in which the same current flows through all the elements

Take a resistance and capacitance in series.

Add an inductance in series with the other elements.

The series connection increased the resistance.
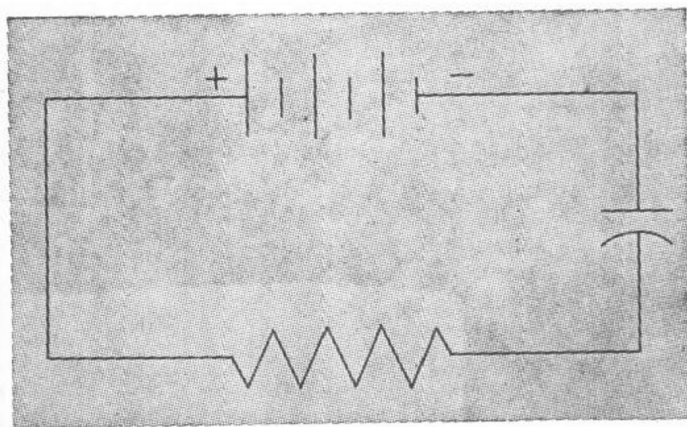
square: as used here, a quantity multiplied by itself

The power is proportional to the square of the voltage.

You should have used the square of the current.

Did you include the square of the charge?

C. Check-Up

Insert the proper terms in the blanks.

|	
battery	inductance
capacitance	power
dissipated	series connection
energy	square

1. Voltage times charge gives _____.
2. Voltage times current gives _____.
3. In a resistance, the energy is _____.
4. The property of _____ is involved with an electric field.
5. The property of _____ is involved with a magnetic field.
6. A circuit connection in which the same current flows through all the elements is called a _____.
'7. Sixteen is the _____ of four.
8. A device which supplies a constant current at a constant voltage is called a _____.
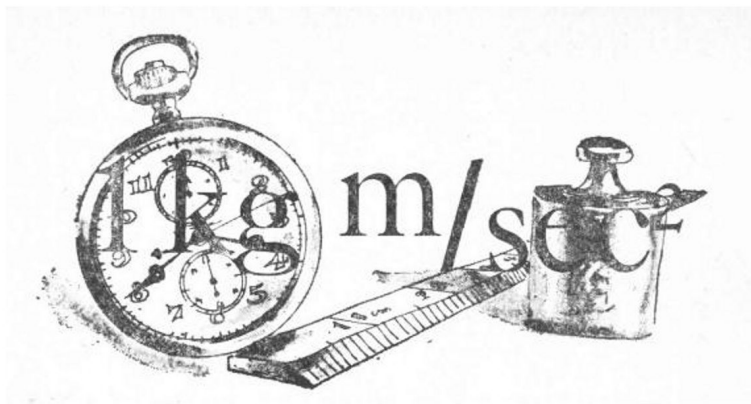
LESSON 3

THE MKS SYSTEM OF UNITS

A. Reading

The CGS and the MKS are the two most commonly used metric systems of units. These initials mean "centimeters, grams, seconds" and "meters, kilograms, seconds." Because of its larger units, the MKS system is more convenient for engineering purposes.

Both systems, when first introduced, used three basic quantities: length, mass, and time. These are sufficient for measurements and descriptions of mechanical phenomena. To deal with electromagnetic phenomena, however, some fourth, electrical, quantity has to be added. The MKS system uses any of the following as the fourth unit: ampere, volt, ohm, henry, farad, or coulomb. Of course, these units are related to electromagnetic theory so that, if one is defined, all the others can be worked out.

On January 1, 1948, the following resolutions were adopted by the International Committee on Weights and Measures:

1. The newton is the force which gives the mass of one kilogram an acceleration of one meter per second per second.

2. The joule is the work done when the point at which one newton is applied is moved by one meter in the direction of the force.

3. The watt is the power which corresponds to the production of energy of one joule per second.

4. The ampere is the constant current which, if flowing in two parallel wires, which are very long, extremely thin, and placed one meter apart in a vacuum, will produce between the wires a force of 2×10^{-7} newtons per meter of length.

5. The volt is the potential difference between two points in a wire carrying a current of one ampere, where the dissipated power between these two points is one watt.

6. The ohm is the resistance between two points in a body having a potential difference of one volt when a current of one ampere is flowing.

7. The coulomb is the charge transported in one second by a current of one ampere.

8. The farad is the capacitance of a capacitor with a potential difference of one volt when it is charged with a charge of one coulomb.

9. The henry is the inductance of a circuit in which one volt is produced when the current in the circuit varies by one ampere per second.

B. Terminology Practice

acceleration: the rate at which velocity changes
    The force gives the mass an acceleration.
    This instrument will measure the acceleration of the car.
    What is the largest acceleration allowable?

ampere: a unit of current
    The system uses the ampere as the fourth unit.
    Your measurements must be in amperes.
    How many amperes would you expect to find?

CGS: the system of units using centimeters, grams, and seconds

The CGS and the MKS are the two most commonly used systems.

The CGS units are used widely by physicists.

The CGS system has simplified measurements.

coulomb: a unit of charge

The system uses the coulomb as the fourth unit.

The charge of this body is 1.6×10^{-19} coulombs.

The coulomb is used throughout the world as a unit of charge.

electromagnetic: having to do with both electric and magnetic phenomena

If electromagnetic quantities are included, a fourth quantity has to be added.

Maxwell is considered the founder of electromagnetic theory.

Electromagnetic waves travel with the speed of light.

farad: a unit of capacitance

The system uses the farad as the fourth unit.

Divisions of the farad are often used.

A microfarad is a millionth of a farad.

henry: a unit of inductance

The system uses the henry as the fourth unit.

This formula gives the inductance in henrys.

A millihenry is a thousandth of a henry.

joule: a unit of energy or work

The joule is the work done.

One joule is 10^7 ergs, where an erg is the CGS unit.

This expression gives the energy in joules.

kilogram: a unit of mass and weight, equal to 1000 grams (2.2046 pounds)

It gives the mass of one kilogram.

It weighs ten kilograms.

Give me the weight in kilograms.

mass: the property of a body that is commonly taken as a measure of the quantity of matter in it

On the moon a man would have less weight than he has on the earth, but the same mass.

The formula $E = mc^2$ relates energy to mass and the velocity of light.