ELECTRIC CIRCUITS

英汉对照科技读物

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江西人民出版社

前　言

为适应学习国外先进科学技术的需要，和帮助读者提高阅读英语科技书籍的能力，我们编注了三十五篇有关电路基本知识的英汉对照读物。文字浅显，内容深入浅出，可作为具有一般英语基本知识的科学技术人员，高、中等技术学校理工科学生，以及对这方面有兴趣的知识青年自修英语的对照读物。

限于编注者的水平，书中难免有错误和缺点，恳请广大读者批评指正。

本书编注过程中，得到周承基和顾伯清二同志的帮助，特表示感谢。

编注者

英汉对照科技读物
Electric Circuits
电　路
忻芝卿　叶惠康　编注
江西人民出版社出版
（南昌百花洲3号）
江西省新华书店发行　江西印刷公司印刷
开本787×1092 1/32　印张8.125
1979年12月第1版　1979年12月江西第1次印刷
印数：1—4500
统一书号：15110·34　定价：0.57元

Contants 目　录

1. Current

As pointed out in the previous section, thermal energy from the surroundings creates a number of[1] free electrons. In the absence of[2] any external electric field, these electrons move in random paths, as in the two-dimensional[3] sketch of Fig.1-1(a). The movement of any one electron is

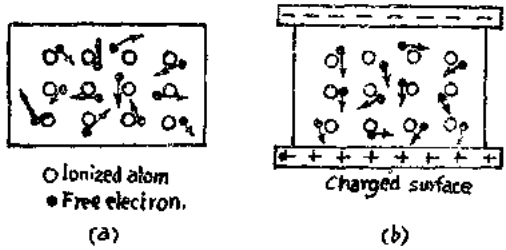

Fig. 1-1 Instantaneous motion of free electrons; (a) no field, no net motion. (b)field applied net motion

offset by the movement of another in an opposite direction so that there is no net movement of electrons. If an electric field is applied though, as in Fig. 1-1(b), more of the electrons move toward the positive plate. The electrons then have a net motion or drift toward the positively charged plate. The drift can be thought of[4] as being superimposed upon the random motion of free electrons.

If an imaginary plane is passed through a conductor,

一、电　流

正如上节所指出的那样，周围环境中的热能会产生一些自由电子。在没有任何外电场的情况下，这些电子的运动是杂乱无章的，如平面简图1—1(a)所示。任何一个电子的运动可被另一个方向相反的电子运动所抵偿，因此电子不存在净运动。但是，如果加上电场，大多数电子就会向正极板运动，如图1—1(b)所示。此时，电子有了向着带正电极板的净运动

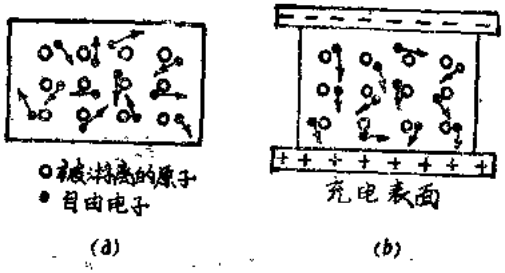

图1—1自由电子的瞬时运动；(a)没有电场，没有净运动；(b)加上电场，有净运动

或漂移。这种漂移可以被认为是叠加在自由电子杂乱运动上的。

假如一根导体（允许电流流动的材料）穿过一个假想的平面（见图1—2），又假如有电场存在，那末就有净电荷流过这个平面。把单位时间内通过给定点的净电子流或净电荷流定义为电流强度。

第一章内曾经指出，电荷的基本单位是库伦。一库伦等于$6.24\times10^{+18}$个电子所携带的电荷。反之，一个电子的电荷就是

a material that allows current flow (see Fig. 1-2), and if an electric field is present, a net flow of charge flows is present, a net flow of charge flows past the plane. The net flow of electrons or charge past a given point per unit time is defined as the electrical current.

As pointed out in Chapter 1, the basic unit of charge is the coulomb. A coulomb is equal to the charge carried by $6.24\times10^{+18}$ electrons. Conversely, then, the charge of one electron is

$$\text{electron charge}=\frac{1}{6.24\times10^{18}}=1.6\times10^{-19}\text{C}.$$

Electrical current, or the rate of flow of charge, is then measured in the units of coulombs per second. The letter symbol for current is I; in equation form the current is

$$I=\frac{Q}{t}\quad\frac{C}{sec}\qquad(1-1)$$

In the MKS system, the basic unit of current is the ampere, where 1 A is the rate of flow of electric current when 1 C of charge flows past a point in 1 sec.

$$1A=\frac{1C}{1sec}\qquad(1-2)$$

Two methods are available for describing the direction of current flow (see Fig. 1-2).

$$电子电荷=\frac{1}{6.24\times10^{18}}=1.6\times10^{-19}库。$$

于是，电流强度，即电荷流动的速率，就用每秒库伦作单位来计量。电流强度的符号是字母 I，用方程来表示即是

$$I=\frac{Q}{t}\ \frac{库}{秒}\ 。\qquad(1-1)$$

在实用单位制内，电流强度的基本单位是安培，1 安就是一库伦电荷在一秒钟内流过给定点电流的速率。即：

$$1安=\frac{1库}{1秒}\qquad(1-2)$$

可用二种方法来描述电流的方向（见图 1－2）。

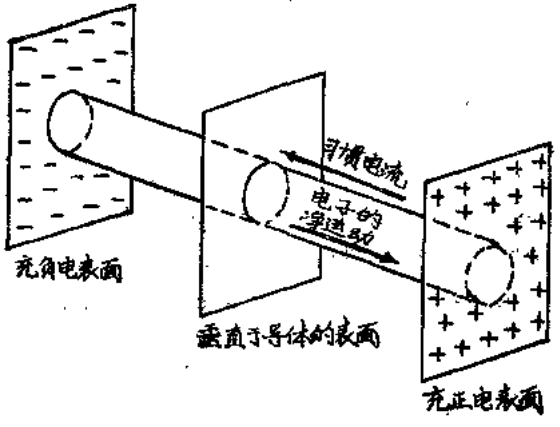

图 1－2　电流的流动

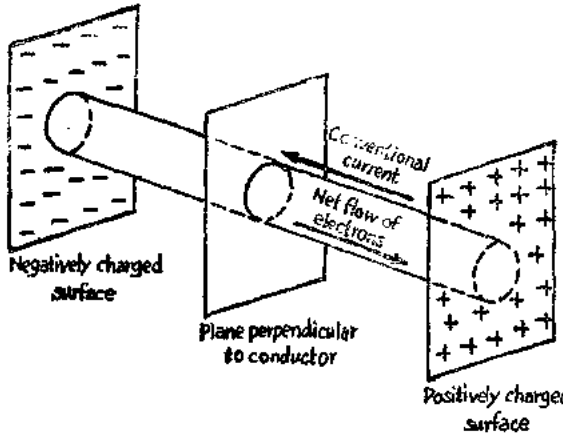

Fig. 1-2. Current flow

Historically, current has been described as flowing from plus to minus, whereas the electron flow is from minus to plus. Either can be specified correctly, because the electron is moving in one direction and the electron vacancy or hole is moving in the opposite direction. The flow of current from plus to minus is referred to[11] as conventional or positive current and has been adopted by the Institute of Electrical and Electronics Engineers (IEEE). Convecurrent will be used throughout this text.

Electrical currents are of two types, direct or alternating. Current that continues to flow in the same direction is called unidirectional current. Direct current (dc) is a constant unidirectional current. Current that periodically reverses direction is called alternating current (ac). Alternating currents generally have a

历史上已经把电流说成是从正流到负，然而电子的流动却是从负到正。这二种说法都是正确的，因为电子向一个方向运动的同时，电子空位或空穴正在向着相反的方向运动。从正到负的电流称为习惯电流或正向电流；这已经被电气和电子工程师学会（IEEE）所采纳。本书也采用习惯电流。

电流有二种类型（直流和交流）。向同一方向连续流动的电流称为单向电流，直流（dc）是一种恒定的单向电流。周期性改变方向的电流称为交流（ac），交流电的频率通常可以变换，为了有助于解决问题，有时要把直流看作频率为零的交流。

1.a number of　一些，若干，
2.in the absence of　缺乏，没有，无…时
3.two-dimensional　平面的，二维的
4.can be thought of as　可被认为是
5.be defined as　被定义为
6.be equal to　等于
7.10^{18}=ten (raised) to the eighteenth (power)
8.f^{-1}=f to the minus one
9.MKS system=Meter-Kilogram-Second system
米·千克-秒制的缩写，在科技术语中常称为实用单位制。
10.be available for　适用于，可用来
11.be referred to as　叫做，称为，被认为是

frequeney of alternation, and it is sometimes helpful to think of direct currents as zero frequency ac.

2. Voltage

In physics, work is described as[1] a force moving an object through a distance, that is,

work = force × distance.

If a positive charge, +QC, is somewhere in space and another charge, a test charge of $+q_t c$, is brought into the vicinity, a force of repulsion is given by Coulomb's law.

$$F = K\frac{Qq_t}{r^2}$$

If the test charge is considered to[2] be an infinite distance away from the +Q charge, the force of repulsion is essentially zero. If the test charge is to be brought closer to the +Q charge, force must be exerted in order to[3] move the test charge against the repulsive force; that is, work must be done. This work increases the potential energy of the test charge, since if the test charge is left free, it will move under the repulsive force back to infinity.

The work required to move a unit charge in an electric field is defined as the electric potential; the rise or fall of potential energy involved in moving a unit charge from one point to another is the potential difference.

二、电　压

物理学中把功描述为：力使物体移动一段距离，也就是

功＝力×距离

假如在空间某处有一个正电荷＋Q库，相邻放着一个试验电荷＋q_t库，那末斥力可根据库伦定律求出：

$$F = K\frac{Qq_t}{r^2}$$

如果该试验电荷离开＋Q电荷无限远，那末斥力基本上为零。如果要使试验电荷靠近＋Q电荷，为了使试验电荷对着斥力移动，就必须对它施加一个力；也就是，必须做功。这个功提高了试验电荷的位能，因为如果试验电荷可以自由离开，那末在斥力的作用下它将回到无限远。

电场中移动单位电荷所需要的功被定义为电位；单位电荷从一点移动到另一点所引起的位能升高或降低就是电位差，于是

$$\text{电位差}=\frac{\text{功}}{\text{电荷}}=\frac{W}{Q}\quad\frac{\text{焦耳}}{\text{库伦}} \qquad (2\text{-}1)$$

在实用单位制内，1焦/库的电位差定义为1伏，用字母V或E来表示：

$$V\text{或}E \qquad 1\text{伏特}=\frac{1\text{焦}}{1\text{库}} \qquad (2\text{-}2)$$

电荷从无限远移到X点所形成的电位称为绝对电位，而电荷从X点移到y点所形成的电位则称为相对电位

Thus

$$\text{potential difference} = \frac{\text{work}}{\text{charge}} = \frac{W}{Q} = \frac{\text{joule}}{\text{coulomb}} \qquad (2\text{-}1)$$

In the MKS system of units, a potential difference of 1J/C is defined as a volt and the letter symbol V or E is used.

$$\text{V or E} \qquad 1 \text{ volt} = \frac{1 \text{ J}}{1 \text{ C}} \quad . \qquad (2\text{-}2)$$

A potential developed in moving a charge from infinity to a point x is referred to as an absolute potential, whereas a potential developed in moving a charge from a point x to a point y is called a relative potential.

In Fig. 2-1 if q_t is a charge of 1C and 10J of work are needed to move it from point x to point y, the relative potential is

$$V = \frac{10 \text{ J}}{1 \text{ C}} = 10 \text{V} .$$

Thus point y is at a potential of 10v relative to point x.

Fig. 2-1 Potential difference between points

图2—1中，如果q_t的电荷为1库，它从X点移到y点所需要的功为10焦，那末相对电位就是

$$V=\frac{10焦}{1库}=10伏$$

这样，y点相对X点的电位为10伏

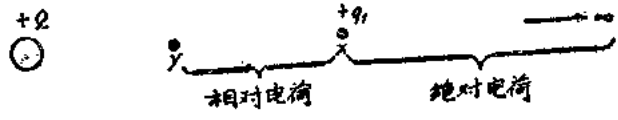

图2—1　各点间的电位差

1.be described as　被描述为
2.be considered to be　被当作是
3.in order to　为了，为…起见

3. Resistance

Resistance is the opposition of a material (or circuit) to the flow of electrical current. The letter symbol is R and the basic unit is the ohm. The Greek capital letter[1] omega (Ω) is used as the unit abbreviation.

Relatively speaking, a conductor has low resistance, whereas an insulator has high resistance.

Resistance properties are discussed more fully in the following chapter, but first we consider the complete electrical circuit that is formed when a source of emf is connected to[2] a load or device which converts electrical energy back into[3] some other form of energy (see Fig. 3-1). The current in Fig. 3-1 travels via a path formed

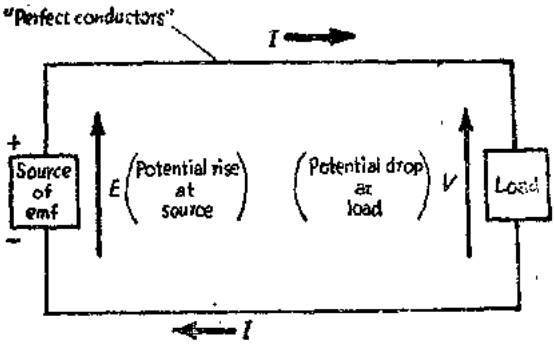

Fig. 3-1 The simple electric circuit

by "perfect conductors" or at least conductors with very little resistance compared to[4] that presented by the

三、电　阻

电阻是材料（或电路）对电流的阻碍作用。电阻的符号是字母R，基本单位是欧姆。单位的缩写用大写的希腊字母Ω（欧米加）来表示。

相对地说，导体的电阻低，而绝缘体的电阻高。

电阻的性质将在下一章内全面地讨论，现在我们先来研究将电动势源连接到把电能变回到其它形式能量的负载或装置上所组成的完全电路（见图3－1）。图3－1上的电流流经由"完全导体"或至少和负载相比电阻是非常小的导体所组成的路径。正如所注意到的那样，电流除了要流过电源上的电位升E，还必须流过负载上的电位降。负载上的电位降就用字母V来表示。

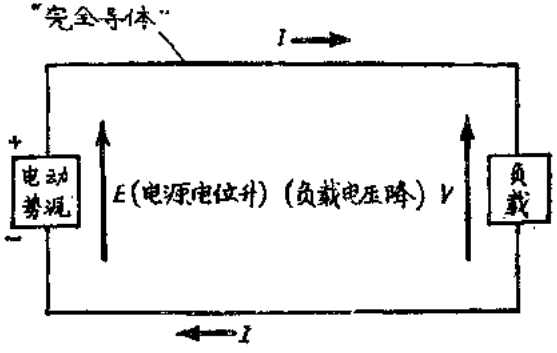

图3－1　简单电路

1.capitel letter　　大写字母
2.be connected to　　与…相连接
3.convert...into...　　把…转换成…