Dictionary of Electrical Engineering

Second Edition

K. G. Jackson
Revised by R. Feinberg

Dictionary of Electrical Engineering

K. G. Jackson
and
R. Feinberg

Butterworths
London Boston Sydney Wellington Durban Toronto

All rights reserved. No part of this publication may be reproduced or transmitted in any form or by any means, including photocopying and recording without the written permission of the copyright holder, application for which should be addressed to the Publishers. Such written permission must also be obtained before any part of this publication is stored in a retrieval system of any nature.

This book is sold subject to the Standard Conditions of Sale of Net Books and may not be resold in the UK below the net price given by the Publishers in their current price list.

First published by George Newnes Ltd, 1965
Reprinted by Butterworths 1973 (with revision), 1975, 1976
Second edition 1981

© Butterworth & Co. (Publishers) Ltd, 1981

British Library Cataloguing in Publication Data

Jackson, Kenneth George
Dictionary of electrical engineering.—2nd ed.
1. Electric engineering—Dictionaries
I. Title II. Feinberg, Raphael
621.3'03 TK9 79-41721

ISBN 0-408-00450-9

Filmset by Reproduction Drawings Limited, Sutton, Surrey.

Printed in England by Hartnoll Print Ltd., Bodmin, Cornwall.

Preface

An electrical engineer is a man of various talents. He may install lighting and power supplies in people's homes; he may erect and service electric motors in a factory. He may be concerned with the laying and jointing of cables; he may be more familiar with a soldering iron in a laboratory. He may erect overhead power supplies, or design high-voltage insulators. He may provide supplies for electric traction, or develop new forms of motor for traction. He may build generators, or design nuclear power stations. He may be seeking new methods of generating electricity, or using old methods of testing equipment. He may write and read papers for the Institution of Electrical Engineers, or his reading may be limited to the Wiring Regulations. Lifts and cranes, insulators and conductors, power transformers and instrument transformers, switching stations and miniature circuit-breakers, 400 kV supplies and 6 V batteries—any one of these may come within his purview. Heating and lighting, welding and melting, mining and flying, clocks and computers—an electrical engineer is involved in each of these fields.

It is not surprising, therefore, that there is a need for a comprehensive dictionary of electrical engineering. Though the present work does not claim to be complete, it does contain something for each of the activities listed in the first paragraph. What has been attempted is to include terms that are of general use among engineers, as well as a selection of the more common or more important terms from each aspect of the subject. It is hoped that, in this way, the book will be of value to all, from the apprentice or student to the experienced engineer trying to keep abreast of his field.

It has been difficult to decide what terms to omit. Some of the entries might be classified as electronics. The justification in these cases is the frequency with which they are encountered by the electrical engineer, or their similarity to other, electrical, terms. Mathematical principles also have been described briefly, where they are of importance to electrical calculations.

An effort has been made to keep the definitions concise, without omitting any necessary information. This has been done with the help of extensive cross-referencing. Key words printed in ***bold italics*** type refer the reader to other entries that will provide

additional necessary or supplementary information. Additional tabulated data will be found in the Appendices.

K.G.J.

Preface to second edition

In revising the dictionary for this second edition, account has been taken of progress in four different directions:

1. Technical developments in the principal areas covered by the dictionary.
2. Increase in the application of electronics in the above areas.
3. Revision of the *International Electrotechnical Vocabulary*, which is issued by the International Electrotechnical Commission (IEC), the supreme international authority on terminology in electrical and electronic engineering. This revision is reflected in the British Standard 4727: *Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms.*
4. The universal acceptance and practice of SI units.

The revised edition contains some 200 new entries and a substantial number of updated entries.

R.F.

此为试读,需要完整PDF请访问: www.ertongbook.com

A

a.c. See ***alternating current.***

a.c. balancer See ***static balancer.***

a.c.b. See ***air-break (-blast) circuit breaker.***

a.c. bridge A ***bridge*** circuit employing alternating current for the measurement of circuit parameters. Balance is more complex in a.c. than in d.c. bridges, because both the magnitude and the phase angle of impedances enter into the balance condition. However, this fact makes possible the precise measurement of reactive components (capacitors and inductors) as well as of resistors.

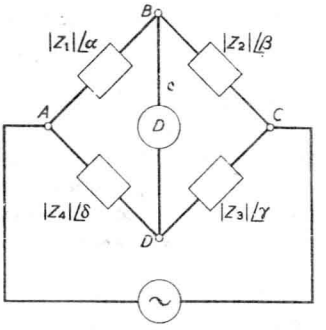

Figure A.1. Four-arm a.c. bridge

In the arrangement of *Figure A.1*, by analogy with the ***Wheatstone bridge***, balance is obtained when

$$Z_1Z_3 = Z_2Z_4$$

that is, when simultaneously

$$|Z_1Z_3| = |Z_2Z_4| \qquad \text{and} \qquad \alpha + \gamma = \beta + \delta$$

Let $Z_1 = R_1 + jX_1$ be the unknown impedance. Then

$$R_1 + jX_1 = (Z_2/Z_3).Z_4 = (Z_2Z_4).Y_3$$

In the former relation, Z_1 is balanced by a variable impedance Z_4 multiplied by a *ratio* (Z_2/Z_3); in the latter, it is balanced by an

admittance Y_3 multiplied by a *product* (Z_2Z_4). Examples of four-arm product bridges are ***Maxwell bridge***, ***Hay bridge*** and ***Schering bridge***. Available for either type of measurement is the ***universal bridge***. Six-arm bridges are the ***Anderson bridge*** and the ***parallel-T bridge*** (see also ***Heaviside – Campbell bridge***).

a.c. calculating table A form of ***network analyser.***

a.c. potentiometer Instrument for comparing alternating voltages. A.C. potentiometers differ from d.c. types as no alternating voltage standard comparable to a standard cell exists. In practice the a.c. potentiometer is usually balanced on direct current against a standard cell, using a transfer instrument which is commonly a precision electrodynamic galvanometer or milliammeter equally accurate on direct or alternating current. This is then used to adjust the a.c. side for balance before use on a.c. measurements. Two general forms exist: the polar, and the quadrature or rectangular coordinate. An example of the polar type is the ***Drysdale potentiometer***, and of the quadrature type is the ***Pedersen potentiometer.***

a.c. resistance Alternative name for ***equivalent resistance***, which is preferred.

a.f. See ***availability factor.***

AWG *American wire gauge.* See ***Brown & Sharpe gauge.***

A-class insulation One of seven classes of insulating materials for electric machinery and apparatus defined in BS 2757 on the basis of thermal stability in service. Class A insulation is assigned a temperature of 105°C. It consists of materials such as cotton, silk or paper, suitably impregnated or coated.

A-connection A three-phase transformer connection between phases which provides a neutral point.

abbreviations See Appendix C.

absolute Independent, unrelated. In temperature, for example, absolute zero as distinct from zero on an arbitrary scale. Abbreviation: abs.

absolute ampere See ***ampere***.

absolute permeability The quotient of the magnetic flux density in a medium by the magnetic field strength. Absolute permeability $\mu = \mu_r\mu_0$, where μ_r is the ***relative permeability*** and μ_0 is the ***magnetic constant***. See ***permeability.***

absolute permittivity The quotient of the electric flux density in a medium by the electric field strength. Absolute permittivity $\epsilon = \epsilon_r\epsilon_0$ where ϵ_r is the ***relative permittivity*** and ϵ_0 is the ***electric constant***. See ***permittivity.***

absolute unit The unit of any system that includes length, mass and time in its fundamental units. Systems of absolute electric units require an additional unit besides the basic mechanical

units. This unit represents either the magnetic or the electric property of space. The three systems of absolute electric units are: m.k.s., electromagnetic c.g.s. and electrostatic c.g.s. (see ***c.g.s. system, m.k.s. system***; see also SI base units in Appendix A.)

absorptiometer see ***absorption meter.***

absorption (1) Conversion of radiant energy to a different form of energy when transmitted through a medium. (2) Incorporation of a bombarding particle into an atomic nucleus with which it interacts. (3) Penetration of a fluid into a solid body.

absorption dynamometer A type of testing brake for measuring the output of electric motors and internal-combustion engines. It absorbs the output as well as measuring it. The simplest form is the friction brake; the force required to restrain the braking device and the distance of its line of action from the axis of the shaft are measured, and the resulting restraining torque, equal to the output torque, is calculated. Alternatively, a magnetic brake can be used in which a metal disk rotates between the poles of electromagnets. For larger outputs the hydraulic dynamometer is suitable and comprises a rotor, fitted with vanes, moving in an enclosed stator also fitted with vanes; admission of water to the device results in turbulence which gives a high braking torque.

absorption factor (1) The ratio of radiation absorbed in a material to the radiation incident on it. (2) An allowance made in interior lighting calculations for light absorbed before reaching the working plane. In clear atmospheres the factor is unity, but it is less when smoke or steam is present.

absorption inductor Deprecated term for ***current-sharing inductor.***

absorption meter Instrument to measure the absorption of light transmitted through a sample of a transparent substance. It uses a light-sensitive detector such as a ***photoelectric cell.*** An instrument of this type may be used, for example, to determine the concentration of a solution.

accelerating machine See ***particle accelerator.***

accelerating relay A device which controls the time interval between the closing of successive resistor-short-circuiting contactors in starting a motor, so providing automatic acceleration. Such relays may be adjustable for time delay (*timing relay*), or of the current-operated type which closes when the current passing through it drops to a predetermined value.

acceleration See ***counter-e.m.f. acceleration, current-control acceleration, time-control acceleration.***

acceptance test A test contractually determined between the manufacturer and customer to prove to the customer the

fulfilment of the conditions of the agreed specification for the device or equipment. See ***commissioning test***.

acceptor circuit A tuned circuit which will accept a signal of one frequency more readily than those of other frequencies.

acceptor impurity An element introduced into the material of a ***semiconductor***, having a lower valency than the semiconductor. It captures electrons to complete its valency bonding, producing a positive charge carrier or ***hole***. This gives rise to *p*-type conductivity. Cf. ***donor impurity***.

access time The time taken to extract an item of information (a number or an instruction) from the store of a ***digital computer***.

accumulator A device for receiving and storing energy, and discharging it, by chemical action. Also known as a ***storage cell*** or ***secondary cell***, the accumulator is reversible, i.e. it can, after discharging, be brought back to a full state of charge by passing a reverse current through it.

A storage cell consists essentially of two electrodes (plates) immersed in an electrolyte in a suitable container. In practice, multiple plates may be used in the cell. There are two basic types: ***lead – acid cell*** and ***steel – alkaline cell***.

Acheson furnace An ***electric furnace*** of the non-melting type for producing silicon carbide. A heavy current is passed through a central core of coke, around which the coke and sand which make the silicon carbide are packed.

acid dip An acid into which chemically cleaned materials are dipped before electroplating in order to remove films of oxide, etc., which would interfere with the plating process.

acoustic controller A form of automatic control by noise level; comprising a microphone, an amplifier, a high-pass filter to segregate the significant noise from low-frequency external noise, and a relay adjusted to operate in accordance with fluctuations in noise above and below a set level. An application is control of the feed motors in a pulverised fuel mill, by noise level inside the pulverising drums.

acoustic sounding A system of determining the depth of the sea-bed or an immersed object, by time-interval measurements of the echo of acoustic waves, using piezo-electric oscillators and recording instruments. The equipment is called *sonar*.

acrylic resin Thermoplastic synthetic resin made from acrylic and methacrylic acids, used as insulating material. Polymethyl-methacrylate (Perspex, Diakon, etc.) is the most important; it is a rigid, clear, transparent resin which can be obtained in flat or curved sheets, rods, tubes, and mouldings made from powder. It is of value for high-frequency use, but has a low softening point which limits it to low-temperature applications.

actino-therapy Ultra-violet therapy, i.e. treatment of disease by radiation with ultra-violet waves (0.40 – 0.25 μm).

active circuit element A source of electric energy. An *active circuit* contains at least one active circuit element.

active component The component of a sinusoidal current or voltage (considered as phasor quantities) which is in phase with the voltage or current (see also ***active power***).

active electrode An electrode of an ***electrostatic precipitator***. The active (discharge) electrode is insulated, and the other (receiving) electrode, usually positive and earthed, collects the precipitated particles.

active power Product of the current and ***active component*** of the voltage or of the voltage and active component of the current.

actuator An electromechanical device for performing a mechanical action, usually with a linear rather than a rotary motion. The motion is speed- and position-controlled in the same way as in a ***servomechanism***.

adaptor A device which may be inserted into a ***socket-outlet*** to receive one or more plugs which may or may not be of the same type as that for which the socket-outlet is intended. The name is also sometimes applied to accessories for insertion into a lamp-holder.

admittance The quotient of current phasor by voltage phasor in a circuit with sinusoidal current and voltage. The SI unit of measurement is the siemens (symbol: S).

advancer See ***phase advancer.***

after-glow Alternative term for ***persistence.***

ageing The gradual change that takes place with time in the useful properties of a material.

air A mixture of gases, water and various pollutions comprising the atmosphere. It is an important insulating medium. The main constituents of clean dry air, by volume, are nitrogen, 78.08%; oxygen, 20.95%; argon, 0.93%; carbon dioxide, 0.03%. Its electric strength is 30 kV/cm (76 V/mil) at 0°C and 760 mm pressure, increasing with pressure.

air-blast circuit-breaker A ***circuit-breaker*** in which the arc is extinguished by a blast of air. It may use compressed air to force the contacts apart as well as to blow out the resulting arc. Very high breaking capacities are possible at alternating voltages from 6.6 kV to 380 kV. In all forms of air-blast circuit-breaker, high-pressure air causes the arcing contacts to open, by pressure either on the contacts themselves, or on an actuating piston. A jet of air sweeps the arc into a low-pressure zone where it is de-ionised and extinguished at a current zero. Arcing times of less than one cycle are possible. Axial-blast, radial-blast and cross-blast jets are

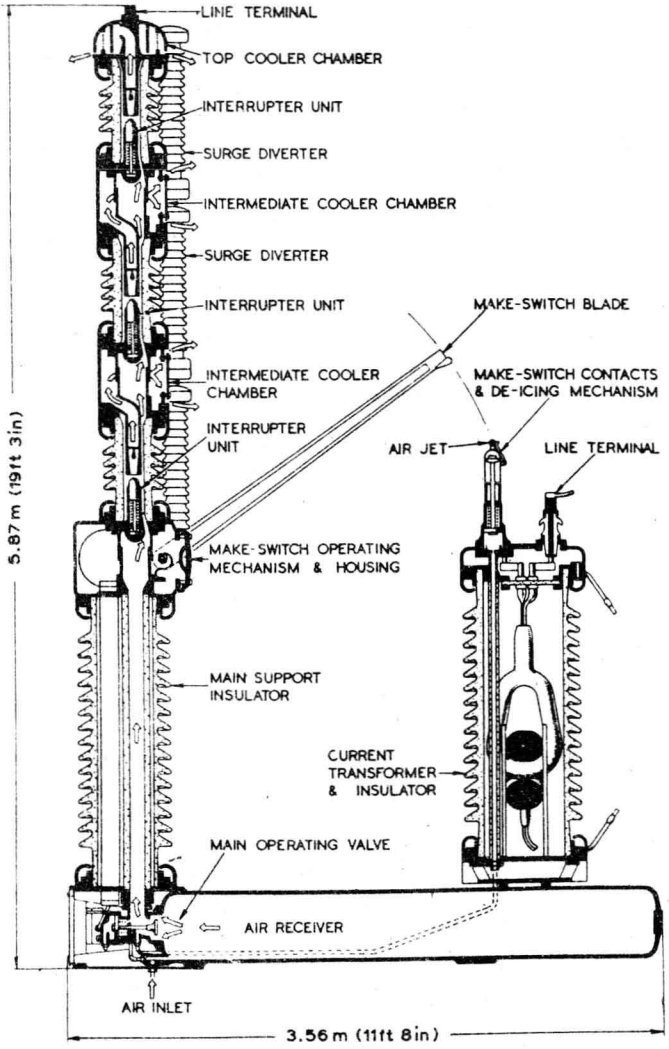

Figure A.2. Sectional drawing of single-pole 165 kV air-blast circuit-breaker (*The English Electric Co. Ltd*)

此为试读,需要完整PDF请访问: www.ertongbook.com

employed, the last being used with arc chutes, for the lower voltages only. Arc chutes are not required for axial- and radial-blast circuit-breakers, but cooling vanes may be built into the exhaust chambers. See *Figure A.2.*

air-break circuit-breaker A ***circuit-breaker*** in which the circuit is opened in air. It utilises 'free' air at atmospheric pressure to extinguish the arc and to provide insulation, thereby avoiding the need for processing of the insulant. Free-air circuit-breakers are manufactured for direct voltages up to 3 kV and for alternating voltages up to 3.3 kV in three distinct forms: low-breaking-capacity a.c. and d.c. circuit-breakers, high-speed d.c. circuit-breakers and high-breaking-capacity a.c circuit-breakers.

air capacitor A ***capacitor*** in which the insulant is air.

air conditioning The production of an artificial atmosphere suited to particular requirements. It may include cleaning, humidifying, dehumidifying, cooling or heating, air movement and possibly ozonising.

air-cooling The carrying away, by means of air, of the heat caused by inevitable losses in the operation of a motor, transformer or other machine. An open type machine may be cooled by natural convection, a protected type by fan or fans mounted on the shaft, and an enclosed type either by a fan mounted internally or externally, or by air blown through in-going and outgoing ventilation pipes.

air core Deprecated term. See ***coreless***.

air gap (1) Part of the magnetic circuit of rotating electric machines and electromagnets, requiring the largest proportion of the magnetomotive force; for example, the space between the rotor and stator of a motor, or between the armature and core of an electromagnet. (2) A point of discontinuity in an overhead conductor for electric traction (see ***section gap***).

air termination Part of a lightning-conductor system designed to collect discharges from the atmosphere or to distribute charge into the atmosphere.

alarm device An instrument to indicate by acoustic or visual means or both the existence of an abnormal situation in the operation of a device or apparatus or system.

Alcomax Trade name for nickel – aluminium permanent-magnet materials exhibiting anisotropic characteristics. The properties in the preferred direction of magnetisation are obtained by heat treatment in a magnetic field, and are very superior to the properties in other directions. See ***nickel alloys***.

alive See ***live.***

alkaline cell See ***steel – alkaline cell.***

alkyd resin Synthetic resin, the condensation products of

polybasic acids with polyhydric alcohols. They are used (non-hardening resins) as adhesives, or (thermosetting types) as finishes or for bonding insulating materials such as asbestos or mica.

all-in tariff An electricity supply *tariff* which does not involve any consideration of the purpose for which the supply is to be used. A domestic supply is usually on a *two-part tariff*.

all-insulated Having all external surfaces protected by coverings consisting entirely of insulating material.

all-or-nothing relay A monostable relay that changes to the energised condition when the power supplied exceeds an upper threshold value and changes to the non-energised condition when the power supplied drops below the lower threshold value.

all-pass network An a.c. network permitting power to pass at a low loss which is independent of frequency.

Allan cell American name for an electrolytic cell for the production of hydrogen by electrolysis of an alkaline solution.

Allen's loop test A fault-localisation test, suitable for finding high-resistance faults in short lengths of cable. It is similar to *Varley's loop test*.

Alni, Alnico Trade names for nickel–aluminium permanent-magnet materials exhibiting isotropic characteristics. Alni was the first commercially used alloy, and is now partially displaced. Alnico has the highest magnetic energy of the isotropic alloys. See *nickel alloys*.

alpha particle Nucleus of a helium atom. It consists of two protons and two neutrons. It has a positive electric charge and may be expelled at high velocity from a disintegrating nucleus of greater complexity.

alphanumeric code A code used in *data processing* where the characters include both letters and numerals.

alternating current, voltage A current or voltage varying with time in a cyclic manner, the current direction and the voltage polarity reversing periodically. Its main value is zero.

alternator An a.c. *generator* having its field windings excited by means of direct current. Alternators may be divided into two types depending on the arrangement of the field system: (*a*) the *turbo type* where the surface of the rotor is a smooth cylinder and the field winding is placed in slots machined longitudinally in the steel (see *turbo-alternator*), and (*b*) the *salient-pole type* having pole pieces, surrounded by the field coils, projecting outwards from a hub.

Alumel A nickel-base alloy containing manganese, aluminium and silicon. It is stable at temperatures up to 1200°C and is used in thermocouples and as an electric resistance alloy. See *nickel*

alloys.

aluminium A bluish-white metal, atomic number 13 and atomic weight 27. It possesses properties of value in electric applications. Pure aluminium is about one-third of the weight of iron, copper, zinc or their alloys. Its electric conductivity is high, and its alloys have high tensile strength. It is corrosion-resisting.

Steel-cored aluminium conductors are widely used for medium- and long-span lines and for very long individual spans. Aluminium wire, usually square, is sometimes used for winding the coils of large lifting magnets to save weight, and it can be insulated to withstand high temperatures. In the form of flat bar, rod or tube, aluminium is frequently used for busbars. Other applications of pure aluminium are for electricity meter disks, and, as pressed or drawn sheet, for electrostatic screening.

aluminium alloy Aluminium combined with another metal or metals, principally copper, magnesium, zinc, silicon, manganese or nickel, to improve its characteristics. Alloy with 5 – 12% silicon is used for busbar casings, since it is non-magnetic, light, and has good casting and reasonable machining properties. High-tensile alloys such as Duralumin are used for the moving parts of switchgear, and result in a reduction of inertia effects. Silicon alloys are used for castings for cage rotors, the percentage of silicon varying between 5% and 12%, depending on the resistivity required. Aluminium alloys containing 2.5 – 5% copper are used for the collector bows used with overhead wires by electric trolleys and locomotives.

aluminium rectifier A type of ***electrolytic rectifier*** comprising cells each with an electrolyte of ammonium phosphate, with an aluminium anode and an inert lead-plate cathode. Such a cell is a unidirectional conductor. The action is chemical as it depends on the forming and reforming of a film on the anode surface. There is appreciable reverse current and the efficiency is low. Only low voltages and currents can be handled by a single cell, but a number may be connected in series or parallel.

American wire gauge (AWG) See ***Brown & Sharpe gauge***.

ammeter An ampere-meter, an instrument for measuring current, with a scale and moving element which carries a pointer. It is connected in series with the circuit carrying the current to be measured and is of low electric resistance or impedance, in order that only a small voltage drop shall be caused in the circuit and a minimum of power absorbed from it. Ammeters may be ***moving-iron, moving-coil, electrodynamic, hot-wire, induction*** or ***rectifier instruments***.

ammeter shunt One or more flat strips of metal alloy, of very low temperature coefficient (e.g. manganin), and of definite

resistance, connected in the main circuit and across the terminals of a moving-coil millivoltmeter which is calibrated as an ammeter.

ammonium dihydrogen phosphate A material, generally known as ADP, showing pronounced piezo-electric effects. It has been used as a transducer element for ultrasonic depth measurement and in submarine detection systems.

amortisseur Damping winding of a machine (see ***damper***).

ampere The SI unit for electric current (symbol: A).

ampere balance A laboratory current-measuring device. A sliding weight balances the force between a pair of coils carried on the weight beam and a system of fixed coils through which the same current is passing.

ampere-hour A unit of electric charge (symbol: Ah). It is the quantity of electric charge that passes in one hour at a current of one ampere. 1 Ah = 3600 coulombs.

ampere-hour capacity The capacity of a battery expressed in ampere-hours, usually based on continuous discharge at a specified rate.

ampere-hour efficiency The ratio between the output quantity in ampere-hours from a battery during a test discharge and the input Ah required to charge the battery.

ampere-hour meter A direct-current electricity-supply meter which measures the current-time summation, or ampere-hours.

ampere-turn The SI unit for ***magnetomotive force*** (symbol: At).

Ampère's law See ***Maxwell's laws*** (I).

amphoteric substance A substance which can dissociate electrolytically in two different ways, so as to give either hydrogen (positive) or hydroxyl (negative) ions, according to conditions.

Amplidyne Trade name for a range of ***rotating amplifiers*** of the cross-field excited type. It is a quick-response d.c. generator, the output of which is controlled by a very small field power. Because of this property, the Amplidyne is particularly suitable for use as an exciter in a closed loop control system.

The method of excitation can be explained by reference to *Figure A.3*. If current is supplied to the control-field winding, a flux (indicated by two dotted arrows) is set up on the vertical axis and induces an electromotive force in the armature conductors between the cross brushes. As these brushes are joined together, the e.m.f. causes a current to flow, and the passage of the quadrature current through the armature windings sets up an armature-reaction field (indicated by the two solid arrows). This field is used to induce the main output voltage of the machine between the other pair of brushes shown on the vertical centre-line.

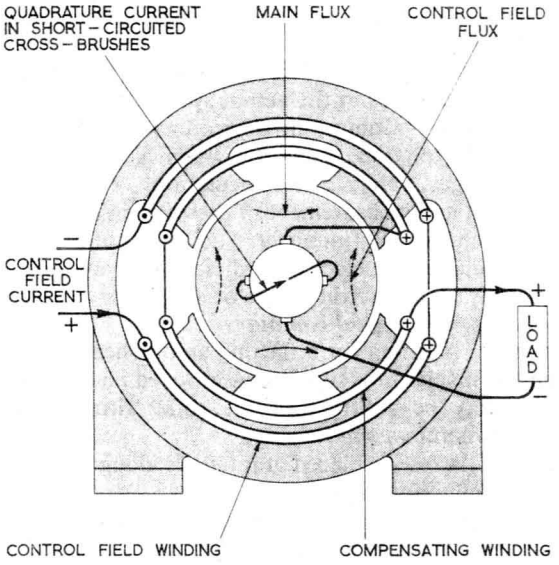

Figure A.3. Internal connections of Amplidyne

The e.m.f. required to pass the quadrature current through the armature winding and the short-circuited cross brushes is small compared with the full output voltage of the machine, and the power needed by the control field winding is therefore only a small fraction of that which would be required to excite the machine in the normal way. In a fully compensated machine the power amplification ratio can be very large (20 000 or more).

amplifier Apparatus for producing a magnified version of an input signal. The term is commonly applied to an electronic circuit for amplifying a voltage applied to its input terminals. See also ***magnetic amplifier, rotating amplifier***.

amplitude The ***peak value*** of a sinusoidal quantity.

amplitude distortion A change in waveform, when deviations in the ratio of the r.m.s. value of the output to that of the input occur for different input amplitudes due to a non-linear response in the system.

amplitude modulation The imposition of a signal shape on to an alternating carrier wave by variation of the carrier amplitude. The maximum signal frequency must be considerably lower than that of the carrier.

analogue A system whose behaviour can be expressed in the same form as that of another distinct system. In particular an electric circuit can be arranged so that its voltages, currents and charges

correspond completely to the forces, velocities and displacements in a mechanical system, with the advantage that the measurement of the electric quantities, whether in the steady or the transient state, are normally very much more direct and simple than the comparable quantities in the actual system.

analogue computer Computing device in which the variables are represented by physical quantities such as lengths, pressures, electric charges, etc., the calculations consisting in the manipulation and measurement of these quantities, the values of which may change continuously. The device of greatest interest in engineering is the electronic differential analyser in which magnitudes such as electric charge or magnetic strength represent the variables. Cf. ***Digital computer***.

anchor clamp A fitting for attaching an overhead-line conductor to a tension insulator or support. A grooved plate clamped down by bolts may be satisfactory for small fittings but heavier conductors require a ***snail clamp***.

anchor tower A ***tower***, placed at intervals along an overhead line to provide longitudinal rigidity.

Anderson bridge A six-arm ***a.c. bridge***, convenient for measuring inductance in terms of a fixed capacitance.

Andreau generator A form of ***wind-power generator***. It is shown diagrammatically in *Figure A.4*. The tubular blades throw air out at their extremities, thus permitting air to enter at the hub from a

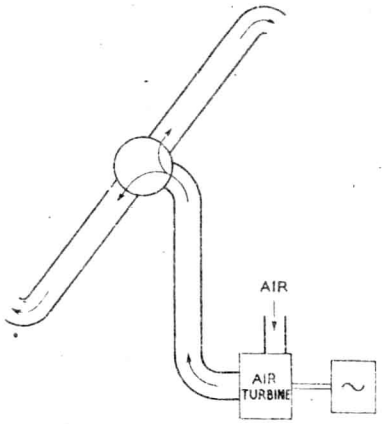

Figure A.4. Andreau wind-power generator. As the wind drives the blades round, air is thrown out centrifugally from the blade tips

duct in which is situated an air turbine driving a generator. This scheme is theoretically less efficient than the more common propeller type, but has the advantage that the generating equipment is fixed and located at ground level.

此为试读,需要完整PDF请访问: www.ertongbook.com