OVER 8,500 DEFINITIONS FOR STUDENTS AND PROFESSIONALS

Web Linked

Oxford

DICTIONARY OF Mechanical Engineering

TONY ATKINS & MARCEL ESCUDIER

OXFORD PAPERBACK REFERENCE

A Dictionary of

Mechanical Engineering

Tony Atkins is Emeritus Professor of Mechanical Engineering at the University of Reading and Visiting Professor at Imperial College. He has authored several books and over 150 journal articles.

Marcel Escudier is Emeritus Harrison Professor of Mechanical Engineering at the University of Liverpool. He has written many journal articles and a book, *The Essence of Engineering Fluid Mechanics* (Prentice Hall, 1998).

SEE WEB LINKS

Some entries in this dictionary have recommended web links. When you see the above symbol at the end of an entry go to the dictionary's web page at www.oup.com/uk/reference/resources/mechanicalengineering, click on **Web links** in the Resources section and locate the entry in the alphabetical list, then click straight through to the relevant websites.

OXFORD
UNIVERSITY PRESS

Great Clarendon Street, Oxford, OX2 6DP,
United Kingdom

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide. Oxford is a registered trade mark of
Oxford University Press in the UK and in certain other countries

First Edition published in 2013

Impression: 3

British Library Cataloguing in Publication Data
Data available

Library of Congress Cataloging in Publication Data
Data available

ISBN 978-0-19-958743-8

Printed in Great Britain by
Clays Ltd, St Ives plc

sectional view The outline, in an engineering drawing, of an object at the cutting plane, together with all visible outlines behind the cutting plane.

section modulus (Z) (Unit m^3) The ratio of the second moment of area of the cross section of a beam to the distance from the neutral axis of the element where the stress is greatest. The maximum bending stress is given by M/Z where M is the bending moment. For a rectangular beam of breadth b and depth h, $Z = bh^2/6$; for a circular cross section of diameter d, $Z = \pi d^3/32$.

sector gear (mutilated gear, segmental gear) A component resembling a gear wheel from which one or more teeth have been removed, employed in intermittent-motion mechanisms.

sedimentation The tendency of dense solid particles to drop through a fluid of lower density due to the influence of gravity. *See also* SETTLING.

Seebeck effect The generation of a voltage V due to a difference in temperature ΔT between two junctions of dissimilar metals in the same circuit. It is the basis of the thermocouple and quantified by the **Seebeck coefficient** (unit $\mu V/K$) defined by $\alpha = V/\Delta T$. *See also* PELTIER EFFECT.

seepage velocity *See* DARCY FLUX.

segmental gear *See* SECTOR GEAR.

segmental meter A variable-head flow meter in which the orifice plate has an opening in the shape of a semi-circle.

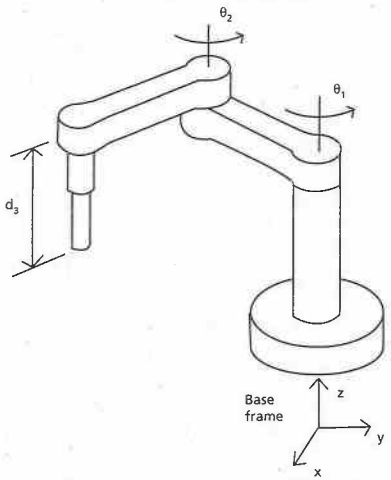
SEGS The acronym for Solar Energy Generating System.

Seiliger cycle *See* SABATHÉ CYCLE.

seismic mass (test mass) The mass in an accelerometer, the inertia of which results in deflexion of the supporting spring when the substrate to which the spring is attached experiences acceleration. *See also* ACCELEROMETER; PIEZORESISTIVE ACCELEROMETER.

seizing up (seizing, seizure) Abrasive damage to one or both metal surfaces which rub against each other, due to partial welding caused by frictional heating. In severe cases, relative movement between the surfaces may be impossible. It occurs e.g. in bearings, or the cylinder of a piston engine where the clearance is too small or there is insufficient lubrication.

Selective Compliance Assembly Robot Arm (SCARA) A robot with a rotational joint, joint angle θ_1, above the base frame; a rotational joint, joint angle θ_2, with axis parallel to the first joint; and a translational joint, joint offset d_3, with axis parallel to the second joint. The robot has high vertical stiffness and is thus particularly suited to assembly tasks. The diagram shows an idealized selective compliance assembly robot arm.



Selective Compliance Assembly Robot Arm

selective emitter A material whose monochromatic emissivity varies with wavelength, angle of incidence, or surface temperature.

selective surface A solar-collector surface for which the energy gain is maximized and the energy loss minimized by optimizing the absorptance (α) and the emittance (ε), both quantities being weighted averages of the monochromatic absorptances and emittances for the surface.

selective transmission *See* GEARBOX.

selector fork *See* GEARBOX.

self-adapting system A control or other system which can adapt to external changes.

self-aligning ball bearing *See* BEARING.

self-excited vibration (self-induced vibration) The vibration of a mechanical system which arises from non-oscillatory motion of the

system. Examples are the shimmy of car wheels and the flutter of an aircraft wing.

self-locking nut A nut with an inherent locking action which minimizes loosening due to vibration. A **self-locking screw** locks itself in place without the need for a separate self-locking nut or lock washer.

self-preserving flow (self-similar flow, self-similar motion) A flow, such as a free jet, wake, or boundary layer, for which the velocity distributions at all streamwise locations have precisely the same shape and can be represented in the form $u/U = f(y/\delta)$ where u is the streamwise flow velocity a distance y from an axis or wall, U is a scaling velocity, and δ is a scaling length. Both U and δ may vary with streamwise location.

self-rectifying turbine A wind turbine that can accept airflow in either axial direction. The aerofoil-shaped blade profile must be symmetric about the plane of rotation, untwisted, and with zero pitch. *See also* WELLS TURBINE.

self-sealing A fluid container, such as a fuel tank or tyre, lined with a substance that seals any small puncture or rupture.

self-similar crack propagation Fracture in which the propagating crack continues in its initial direction.

self-tuning regulator (STR) An adaptive control system in which the parameters in the controller, for example the gain and time constants, are automatically adjusted by a second control loop as a consequence of observed performance of the system.

sem An abbreviation for pre-assembled washer and screw: a machine screw with a washer, or washers, permanently attached under the screw head.

SEM *See* SCANNING ELECTRON MICROSCOPE.

semi-closed cycle gas turbine A gas turbine in which less than 100% of the working fluid is recycled.

semi-diesel engine A piston engine which uses heavy oil as a fuel but operates at a lower pressure than a conventional diesel engine. The fuel is either sprayed against a hot surface or spot, or ignited by precombustion or supercharging of part of the charge.

semi-elliptic spring (leaf spring, carriage spring) A spring consisting of one or more layers of arc-shaped metallic plates of progressively decreasing length, joined to act as a single unit.

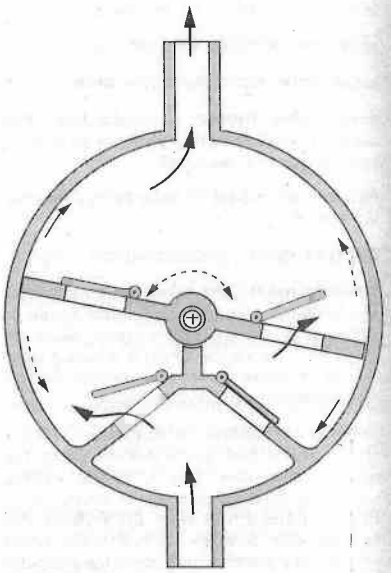
semi-floating axle An axle that transmits torque and carries wheel loads at its outer end.

semi-inverse method A method of obtaining the solution of a problem in elasticity in which certain assumptions are made at the outset. If it can be shown that, with these assumptions, the equations of equilibrium and the boundary conditions are satisfied, it follows from the uniqueness of solutions in the equations of elasticity that the solution obtained is exact. This method was first used by Saint-Venant, to solve the problem of torsion of prismatic bars.

semi-perfect gas *See* PERFECT GAS.

semi-permeable membrane 1. An idealized membrane which is permeable to a single gas in a mixture of gases. **2.** A membrane that is permeable to molecules of the solvent but not the solute in osmosis.

semi-rotary pump A form of self-priming pump, often hand-operated, suitable for pumping water and light oils such as diesel oil and



semi-rotary pump

tion air and sometimes also the fuel, typically using an annular array of angled guide vanes (the **swirler**), to enhance mixing between the air and fuel and create a region of recirculation for flame stabilization. A quarl is usually located just downstream of the guide vanes. *See also* ROTARY-CUP BURNER.

swirl chamber A container in which swirling flow occurs, such as in the cylinder of a piston engine to promote mixing, a cyclone separator, vortex amplifiers, and vortex diodes.

swirl flow (swirling flow) A fluid flow in which the fluid particles have a tangential component of velocity about an axis which, when combined with an axial component of velocity, produces a helical or spiral flow.

swirl flow meter A flow meter in which a swirler creates a swirling flow and a sensor then detects oscillations in the flow which have a frequency proportional to the volumetric flow rate.

switching flow *See* FLUIDICS.

switching surface In a bang-bang feedback controller, the surface in state space which separates regions of maximum positive and maximum negative control effort.

swivel (swivel joint) A coupling component which allows an attached object to turn freely.

swivel block A block incorporating a sheave which can turn freely on its shackle or other support.

swivel coupling A connection between two pipes or pipe fittings which allows one to be rotated relative to the other.

swivelling propeller A propeller attached to a shaft which can be turned so that thrust can be delivered in any direction. *See also* THRUST VECTORING.

swivel pin *See* KINGPIN.

sylphon bellows A thin-walled axisymmetric metal bellows.

symbols on drawings Standard symbols used in engineering drawings to show diameter, machining and surface texture, projection system, tapers, welding, etc., as specified in ISO 128.

symmetry axis *See* AXIS OF SYMMETRY.

synchromesh *See* GEARBOX.

synchronous A term for events occurring simultaneously.

synchronous belt *See* TIMING BELT.

synchronous vibrations Vibrations that have the same frequency and phase, but may differ in amplitude.

syngas (synthesis gas) A gas mixture, primarily hydrogen and carbon monoxide, produced by gasification of coal, biomass, and waste matter, and in steam reforming of natural gas to produce hydrogen. It can be used as a gaseous fuel, or as feedstock to produce liquid fuels. *See also* PLASMA.

system **1.** In control engineering, a control system is a collection of components designed to cause a plant to produce an output that follows accurately a desired behaviour. **2.** In systems engineering, a system is an aggregation of end products and enabling products to achieve a given purpose. **3.** In thermodynamics and solid mechanics, a system is a quantity of matter or a region in space selected for study. The matter or space outside the system is called the surroundings. The real or imaginary surface which separates the system from its surroundings is called the boundary. *See also* CLOSED SYSTEM; ISOLATED SYSTEM; OPEN SYSTEM.

system analysis The determination of how a set of interconnected components will respond in total given a knowledge of the behaviour of the individual characteristics of the components.

systematic error *See* ERROR (1).

system bandwidth In a control system, the bandwidth is the input frequency at which the output has dropped by −3dB relative to the output for a same-magnitude low-frequency input.

system boundary The real or imaginary surface which separates a thermodynamic or solid mechanics system from its surroundings.

system design The design of a complex engineering product by the selection of individual sub-systems, based on knowledge of the behaviour of each sub-system without reference to their detailed design. For example, a motor, gearbox, and ball screw could be combined to make a product that gives translational motion. A system-design approach would match the three sub-systems based on the input-output

relationships of each, without considering their internal design or operation.

systems engineering (system engineering) A methodology which integrates all disciplines and specialty groups into a team effort, forming a structured development process that proceeds from concept to production to operation.

system type (type) The highest order of the time-domain differential equation required to properly describe a system. This is equal to the highest power of s in the denominator of the transfer function.