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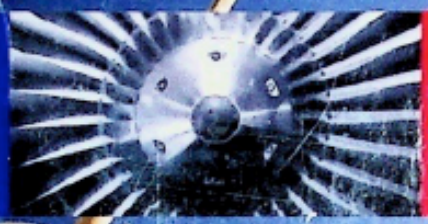

DICTIONARY OF Mechanical Engineering

TONY ATKINS & MARCEL ESCUDIER

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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).

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high-solidity wind turbine A wind turbine with a large number of blades, typically overlapping, so giving the impression of a solid disc. *See also* LOW-SOLIDITY WIND TURBINE.

high strength low alloy steels (HSLA steels) Steels with various micro-alloying elements such as copper, nickel, chromium, molybdenum, niobium, titanium, and vanadium in small quantities that give improved strength (as high as 900 MPa) and corrosion properties compared with plain carbon steels. Improvements are due to grain refinement and precipitation hardening, better control of the chemistry during steel making, and accurate rolling temperatures. *See also* CONTROLLED ROLLED STEEL; DUAL-PHASE STEEL.

high-technology robot A robot equipped with advanced sensors, such as a vision system, and a sophisticated controller allowing it to adapt to changes in its environment.

high-tensile bolt (high-tension bolt) A bolt manufactured from an alloy steel that has a high tensile strength of about 1 GPa.

Hill's spherical vortex (Hill's vortex) A recirculating viscous flow for which vorticity within a spherical volume varies linearly with radial distance from its centre.

Hilsch tube *See* RANQUE–HILSCH TUBE.

hinge 1. (hinge joint) *See* PIN JOINT. **2.** *See* PLASTIC HINGE.

hipping (HIP) *See* HOT ISOSTATIC PRESSING.

hob *See* TOOTHED GEARING.

hobbing *See* TOOTHED GEARING.

Hodgson number (*Ho*) A non-dimensional parameter used to characterize the damping effect, on an in-line flow meter, of a receiver installed in a pulsating flow system. It is defined as $HO = f\mathcal{V}\Delta p/\dot{\mathcal{V}}\bar{p}$ where f is the fundamental pulsation frequency, $\mathcal{V}$ is the volume of the receiver between the pulsation source and the flowmeter, Δp is the average pressure loss across the flow meter, $\bar{p}$ is the mean static pressure in the receiver and $\dot{\mathcal{V}}$ is the volumetric flow rate.

hodograph 1. (velocity diagram) A graphical construction in plane kinematics for acceleration, in which the velocity in the hodograph is equal to the acceleration in the actual motion. **2.** The name employed in plasticity theory for the vector diagram of particle velocities.

hohlraum A large cavity with a small opening. Radiant energy entering the cavity undergoes repeated reflections so that very little of the incident energy is re-emitted and the cavity has the characteristics of a black surface.

hoist A machine with a winding drum for lifting from directly above the load.

holdup In multiphase-phase flow in a tube or column, the ratio of the cross section of any one component at a particular location to the total cross section, and so effectively a volume fraction.

hole-basis fit *See* LIMITS AND FITS.

hole flanging The forming process in which a punch is passed through an already-existing hole in a sheet to form a circular wall on the far side of the hole.

hole saw *See* TREPANNING TOOL.

Holland's formula An approximate equation used to estimate the rise of a buoyant plume of exhaust gas or vapour from a stack, taking into account the stack height and diameter, the prevailing airspeed, temperature and density, and the effluent velocity and temperature at the stack exit.

hollow punch A thin-walled punch used with softer materials for cutting out discs or making holes.

holography A method of recording and displaying a three-dimensional image (a **hologram**) of an object, usually using coherent radiation from a laser. A hologram is formed on a photographic plate by interference patterns between direct and reflected light, the image being reproduced by illuminating the plate with coherent light. Applications of holographic interferometry include stress and vibration analysis.

Holzer's method A method to determine the natural frequencies of torsional vibration of a built-up system (such as a crankshaft, connecting rods, and pistons) that is idealized as a number of discs on a rotating shaft. It can also be applied to flexural vibrations as an alternative to Stodola's method.

homenergic flow *See* ISENERGIC FLOW.

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piecewise linear system A system in which non-linear behaviour can be approximated by a series of linear functions, each applicable over different intervals.

piercing The punching of holes in metal sheet or plate where, in contrast to blanking, the remaining stock is the required component.

piezoelectric effect The acquisition of electrical charge by certain crystalline materials, such as quartz, barium titanate, lead zirconate, and lead titanate, when compressed, twisted, or otherwise distorted. Used e.g. in **piezoelectric detectors** such as load cells.

piezometer (piezometer tube) An instrument for measuring liquid pressure. The most basic version consists of a vertical, open-top tube, of diameter large enough that capillary effects are negligible, with its lower end immersed in the liquid: the liquid height h within the tube is a measure of the pressure difference Δp compared with the ambient pressure based on the hydrostatic equation $\Delta p = \rho g h$ where ρ is the liquid density and g the acceleration due to gravity.

piezoresistive accelerometer An accelerometer in which a seismic mass exerts a force on a piezoresistive substrate and the resulting change in resistance can be used to estimate the acceleration of the seismic mass.

piezoresistive effect In metals, the change in resistance of a material due to changes in its geometry when subjected to stress; in semiconductors, such as germanium and silicon, there is a much larger effect due to changes in the resistivity itself. Some pressure transducers make use of the effect.

piezotropic fluid A fluid for which the density ρ is a single-valued function of pressure p. For example, p/ρ^{γ} = constant which describes the behaviour or of a perfect gas with specific-heat ratio γ undergoing an isentropic process.

pilger mill A machine for producing seamless tubing from pierced metal billets by hot rolling over a mandrel that returns to its starting position after every bite of the non-circular rolls elongates part of the billet. The intermittent process is so named after the pilgrims' chorus in Wagner's opera *Tannhäuser*.

Pilkington process *See* FLOAT-GLASS PROCESS.

pillar drill A self-standing drilling machine.

pilot bit (pilot drill) A small-diameter drill used to drill a **pilot hole** into a material prior to a larger hole being drilled, in order to locate the drill bit and prevent it from wandering.

pilot-controlled valve A valve installed in a flowline, the pressure or flow rate in which is controlled by a pilot valve installed in a by-pass line.

piloted ignition A method of ignition in which the initial energy for combustion to occur is provided by a spark or small flame.

pilot light (pilot flame) A constantly-burning small flame used to ignite a gas burner.

pilot valve (relay valve) A valve controlling pneumatic or hydraulic flow that is operated by pneumatic or hydraulic pressure. Such a valve allows a small pressure or flow of fluid to control a larger pressure or flow, and thus effectively provides amplification.

pin 1. A small-diameter cylinder projecting from a surface, sometimes used as an axle or spindle. 2. A cylindrical or conical component passing through a shaft and a hub to prevent relative axial movement between them.

pinion *See* TOOTHED GEARING.

pin joint (hinge, hinge joint, revolute joint) A joint in a mechanism or framework, such as a truss, where the connection is a pin about the axis of which both parts can turn without restriction. Forces are transmitted, but not moments.

pinking (pinging) *See* ENGINE KNOCK.

pinned *See* FIXITY.

pint Obsolete (non-SI) British unit of volume, equal to $0.568261500 \times 10^{-3}$ m^3.

pintle 1. A pivot pin, as in a hinge or rudder. *See also* GUDGEON. 2. The end of the injection spindle which atomizes the fuel in a fuel injector for an internal-combustion engine.

pintle chain A series of open links connected by pins that articulate within the barrels of adjacent links, used to transmit power between sprocket wheels. Typically used in agricultural machinery.

pipe A metal, plastic, or glass tube of circular cross section.

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Mechanical Engineering

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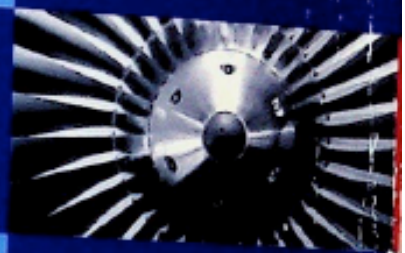

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