

Mechanical design of instruments

4: Kinematic components (Part B)

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Transference of rotary motion

As in electrical systems, mechanical counterparts require means to transfer signals between sub-units of the system. These signals may have to be transmitted at the direct unity ratio or be operated upon to alter this ratio, up or down. The motion may need to be converted into such motions as intermittent, quick return and others.

Transferring signals and forces over large distances in mechanical equipment is more difficult than with electrical signals. Generally, today's practice would now convert mechanical information into electronic for long distance transmission. This was not always so and there still exist applications where direct mechanical transfer is more secure, more reliable and more easily serviced.

Mathematical uses of mechanisms are covered in more depth in a later part on computing mechanisms. Here will be discussed those components that, whilst not generally being thought of as computing elements, nevertheless might be used in that manner and should be regarded in that light. It is important to see coupling systems in this way for there are many traps to fall into because of imperfections of components and mechanism concepts. Covered here are the shaft coupling devices, gears of the various kinds, cams, flexible belt type, drives and electro-mechanical gearboxes.

The form and design of these components are well covered in the general machine design texts such as those already mentioned, Peatfield (1951), Faies (1955), Beggs (1955), Mabie and Ocvirk (1958) and Lent (1970). Information specifically relating to instruments is given in Trylinski (1971) and Reliance Gear (1972). Because of the extensive use of gears and other couplings in industry, many national standard specifications are in existence.

Couplings

When coupling two shafts together as a direct drive the factors to be considered are the amount of misalignment that must be tolerated, the constancy of the velocity and positional form transmitted within a revolution, the torque level, the distance between supports to reduce shaft whirl, damping of vibration, stiffness needed in closed-loop control, allowance for end-float and more severe longitudinal movement, ease of assembly and such factors as availability and cost. A sample of the range is shown in Fig. 4.7.

Constant-velocity couplings began with the design of Hooke reported in 1674. The single Hooke joint, however, does not give a constant velocity (or position) ratio between the input and the output. Two can be used together, in series, so that the modulation imposed by one is cancelled by the other. Other more compact forms of

constant velocity joints were later developed for the automotive industry, examples being the Bendix-Wiess, Rzeppa and Tracta joints. These, in general, have not been produced at instrument size. They have the advantage of providing constant velocity from a single coupling joint. The above coupling stages require the two coupled shafts to be positioned such that their extended centre-lines intersect in the coupling centre. A double Hooke joint can, however, also take up translational as well as angular, misalignments.

Where two shafts are parallel, but not in line, the Oldham coupling can be used. This allows for misalignment by a sliding, cross shaped connector.

A solid, or rigid, coupling can only be used where the two shafts are aligned to exacting tolerances. If they are not, the coupling will 'work' on its screws or bend the shafts causing looseness or failure to occur. Coupling drives come in many forms, see Reliance Gear (1972) and Trylinski (1971) for illustrations of the various instrument kinds: the latter work presents the geometrical theory for many designs. The following names are used in the literature for the various kinds of couplings: slip-joint and slip-couplings, membrane, spring and self-locking spring, anti-backlash, bellows, moulded plastic flexible, universal lateral, Kudriavetz, Flex-thane multiple polyurethane pins, multi-jaw, sleeve, slip-clutch, over-running clutch and phase adjust (a type in which the relative shaft phase can be slightly adjusted by a small screw rotation). There is no shortage of design possibilities; each has advantages and disadvantages and must be matched to the application.

Where the motion deliberately has not to provide constant velocity or positional adherence to the input form, intermittent drives may be used. These include the quick return, Geneva, intermittent gear drives and the various forms of clockwork escapement mechanisms. Many couplings used make use of elasticity to allow for misalignment. In these instances it is unlikely that they will be of use if information fidelity or smooth unmodulated drive is needed through the link.

Gears

Although the toothed gear was in use in ancient times, it was not until more recently that it could be used extensively due to the relatively low cost resulting from mass-production and good quality control of the form and size of the two parts involved.

Gears are used to alter (or maintain) the ratio of speeds between two turning or partly rotating shafts. Many forms exist that enable the directions of the two shafts to be placed at any angle and displacement required. The main limitation of gears is that the shafts involved must be

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Research and Design of Snow Hydrology Sensors and Instrumentation Raman K. Attri, 2018-12-28 This book is a collection of seven in depth and detailed research papers authored by Dr Raman K Attri between 1996 to 2005 The book presents early career scientific work by the author as a scientist at a research organization The book provides the conceptual background and key electronics and mechanical design principles used in designing sensors and instrumentation systems to measure snow hydrological parameters The systems discussed in this book can be used to measure snow depth layer temperature temperature distribution profile surface porosity etc The snow parameters measured from instruments and sensors discussed in this book are integrated into larger systems and are used in computer driven models for snow avalanche predictions The book presents the design challenges and design methods from electronics and instrumentation design point of view While the book provides essential understanding of analog electronics design and associated mechanical design for snow hydrological sensors the book also presents the background theoretical and mathematical models from snow hydrology physics that governs this electronics design The first research paper discusses the design control techniques used to the design a remote surface detector to detect objects with porous uneven irregular surfaces like snow using ultrasonic beams The second research paper describes signal processing techniques and electronics design approaches to design a snow depth sensor with improved sensitivity and directional response using Ultrasonic Pulse Transit Method The third research paper explains theoretical and mathematical model that governs the physical mechanical and electronics design to implement the theory of Arrayed Ultrasonic transducers to shape up the directional response and beam width of an ultrasonic beam to improve the chances of receiving sufficient reflection from the non smooth highly porous uneven non planar irregular snow surface The fourth paper presents the design considerations and performance characteristics of Snow Temperature Profile Sensing System used to measure the temperature gradient and temperature distributions within and outside the snowpack at different depths The fifth research paper focuses on describing the design of Snow Temperature Profile Sensing System in details and discusses the theoretical and mathematical model that outline important temperature parameters Then the paper describes how the system is implemented to record or measure those parameters The sixth paper presents the design considerations constraints and design techniques used to use RTD temperature sensors for snow temperature measurement applications The paper also presents the performance evaluation and suitability of such sensors The seventh paper focuses design techniques for front end analog signal conditioning module and the design challenges faced when interfacing analog unit to a data acquisition system The eighth paper describes the design of snow air temperature sensing probe and methods to ensure that it measures true air temperature over a snow cover and is not influenced by solar radiations and winds The

book may be read as an applied text book in conjunction with standard electronics and instrumentation design textbooks The book will guide students on how to apply basic principles of instrumentation systems design integrate concepts of physical sciences and measurement sciences for the field applications **Machine Design** ,1929 **Mechanical Engineering** ,1919 **Journal of Scientific Instruments** ,1926 **Functional Reverse Engineering of Machine Tools** Wasim Ahmed Khan,Ghulam Abbas,Khalid Rahman,Ghulam Hussain,Cedric Aimal Edwin,2019-09-23 The purpose of this book is to develop capacity building in strategic and non strategic machine tool technology The book contains chapters on how to functionally reverse engineer strategic and non strategic computer numerical control machinery Numerous engineering areas such as mechanical engineering electrical engineering control engineering and computer hardware and software engineering are covered The book offers guidelines and covers design for machine tools prototyping augmented reality for machine tools modern communication strategies and enterprises of functional reverse engineering along with case studies Features Presents capacity building in machine tool development Discusses engineering design for machine tools Covers prototyping of strategic and non strategic machine tools Illustrates augmented reality for machine tools Includes Internet of Things IoT for machine tools **The Optician and Scientific Instrument Maker** ,1926 **Dictionary of Occupational Titles** ,1977 Supplement to 3d ed called Selected characteristics of occupations physical demands working conditions training time issued by Bureau of Employment Security **Dictionary of Occupational Titles** United States Employment Service,1977 **Thesaurus of ERIC Descriptors** ,1977 **Instrumentation Reference Book** Walt Boyes,2009-11-25 The discipline of instrumentation has grown appreciably in recent years because of advances in sensor technology and in the interconnectivity of sensors computers and control systems This 4e of the Instrumentation Reference Book embraces the equipment and systems used to detect track and store data related to physical chemical electrical thermal and mechanical properties of materials systems and operations While traditionally a key area within mechanical and industrial engineering understanding this greater and more complex use of sensing and monitoring controls and systems is essential for a wide variety of engineering areas from manufacturing to chemical processing to aerospace operations to even the everyday automobile In turn this has meant that the automation of manufacturing process industries and even building and infrastructure construction has been improved dramatically And now with remote wireless instrumentation heretofore inaccessible or widely dispersed operations and procedures can be automatically monitored and controlled This already well established reference work will reflect these dramatic changes with improved and expanded coverage of the traditional domains of instrumentation as well as the cutting edge areas of digital integration of complex sensor control systems Thoroughly revised with up to date coverage of wireless sensors and systems as well as nanotechnologies role in the evolution of sensor technology Latest information on new sensor equipment new measurement standards and new software for embedded control systems networking and automated control Three entirely new sections on Controllers Actuators and Final Control

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