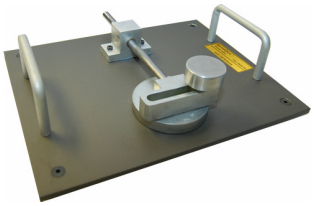
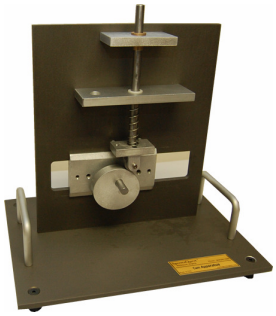
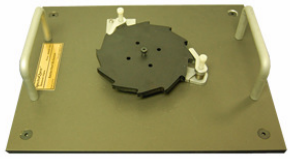
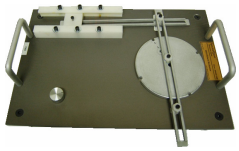
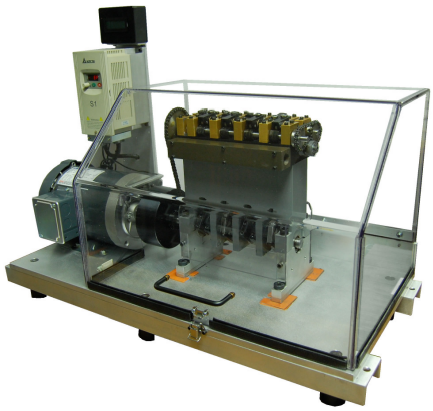
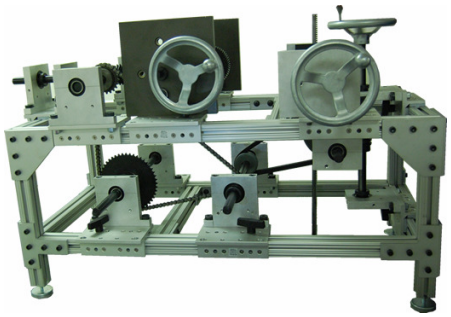
Kinematics & Dynamics of Machines



Enhance Learning of Kinematics and Dynamics Principles

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SIMULATORS

Kinematics & Dynamics of Machines

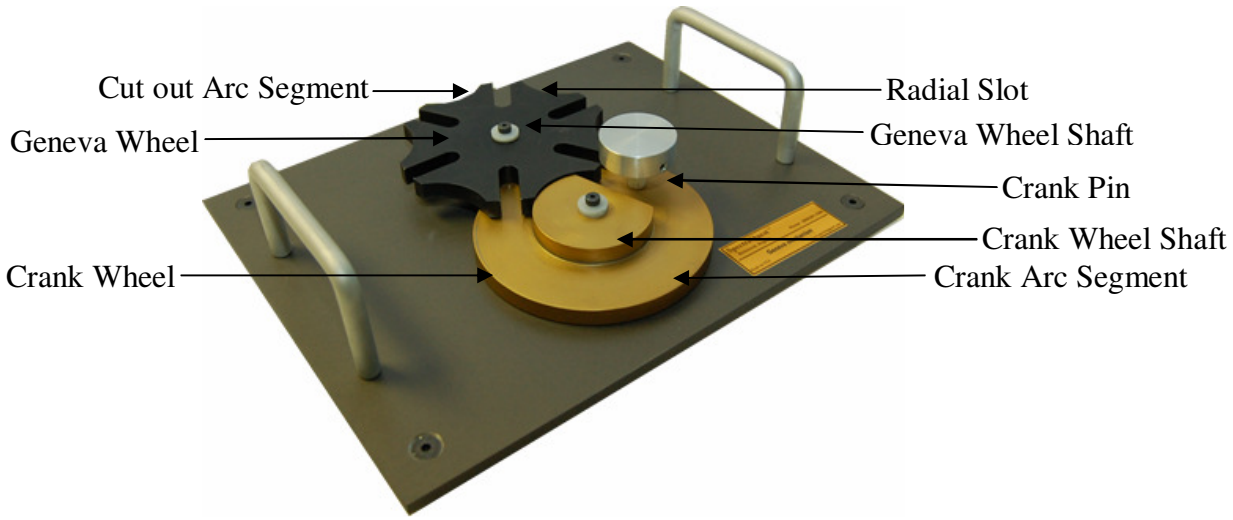
Uniquely Designed Apparatus to Enhance Learning

SpectraQuest offers a series of devices to enhance learning of kinematics and dynamics principles of a typical machine. Each apparatus is designed to visually illustrate sometimes elusive concepts to expedite learning. We also offer a set of instrumentations including sensors, data acquisition hardware, analysis and simulation software, and training manual to go along with applicable product. The devices are grouped as Kinematics and Dynamics according to the applications and associated demonstration.

Kinematics	**Dynamics**
❖ Slider Crank Mechanism	❖ Static and Dynamic Balancing Simulator
❖ Four Bar Chain Mechanism	❖ Balance of Reciprocating Masses Simulator
❖ Scotch Yoke Mechanism	❖ Centrifugal Governor
❖ Hooke's/Universal Joint Demonstrator	❖ Gyroscope
❖ Quick Return Mechanisms	❖ Centrifugal Force Demonstrator
❖ Ackermann Steering Demonstrator	❖ Coriolis Force Demonstrator
❖ Cam/Follower Mechanism	❖ Hydrodynamic bearing Simulator
❖ Gears and Gear Train Demonstrator	❖ Flywheel Apparatus

Geneva Mechanism

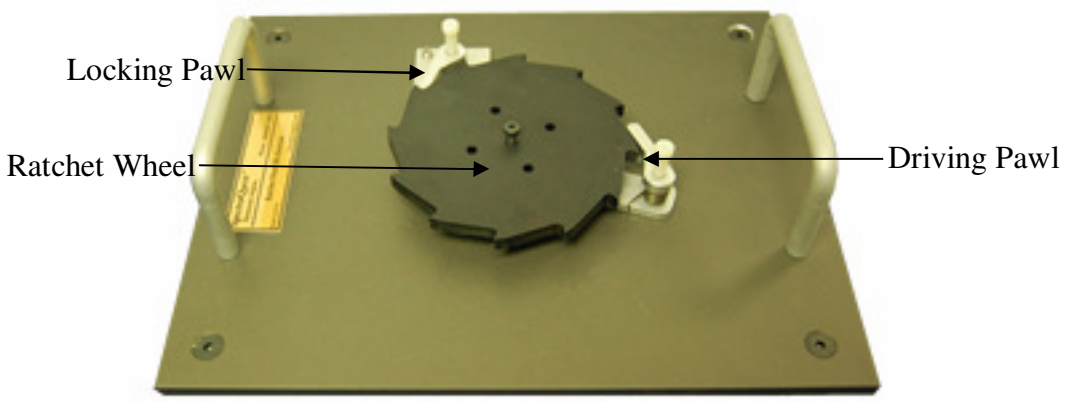
The Geneva Mechanisms are often used in applications requiring indexing or intermittent rotational motions (a series of rotation followed by dwell sequences). The mechanism consists of a Geneva wheel, a crank wheel, a crank wheel shaft, and a crank pin as shown in the picture below. The wheel shown here has six radial slots and six arch segments. In this case, the Geneva wheel is turned 60 degrees for each rotation of the crank wheel. Both the number of dwell periods and rotations depends on the application. The number of radial slots in the Geneva wheel is determined by the number of dwell period and the dwell time is determined by the rotational speed of the crank wheel.



In order to avoid infinite acceleration, the slot axis must be tangent to the circle traversed by the crank wheel pin center.

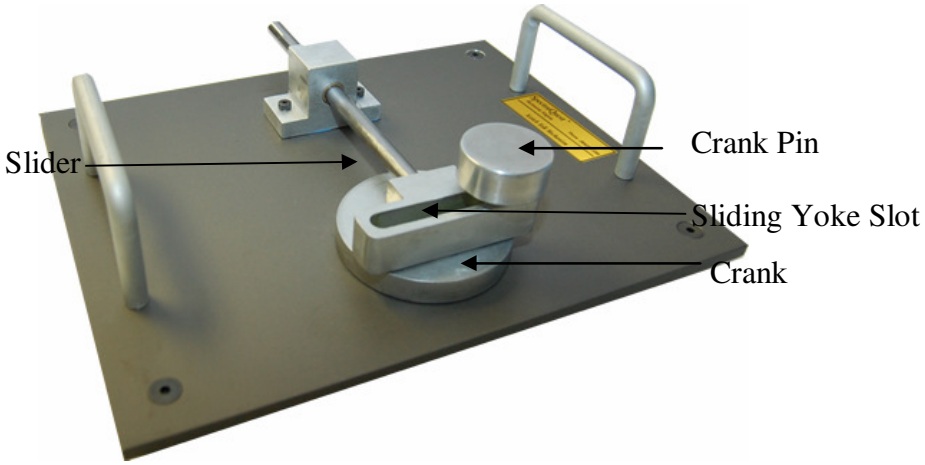
Ratchet Pawl Mechanism

Ratchet is form of gear in which the teeth are cut for one way operation. Ratchet pawl mechanism is used in lifting equipment and to preventing the reverse rotation when the input force is removed. This mechanism is also used in wrenches. The pawl engages the ratchet teeth, is pivoted at one end and the other end engages with the ratchet teeth. Both the locking and driving pawl are spring loaded to maintain constant contact against the ratchet wheel.



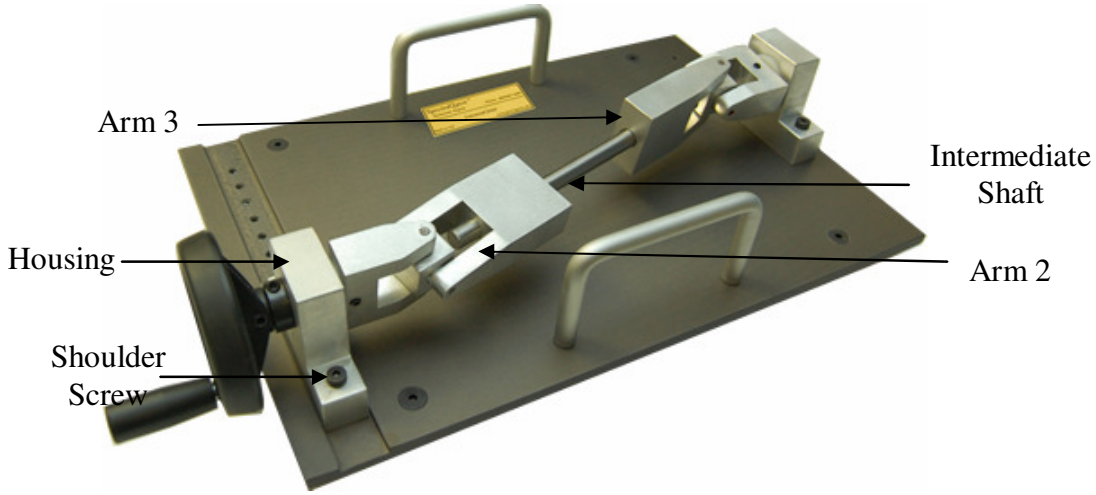
Scotch Yoke Mechanism

Scotch yoke mechanism is used for converting rotational motion of the crank into linear motion of slider or vice versa. For constant rotational speed of the crank, the slider gives simple harmonic motion. As the crank wheel rotates the crank pin slides along the slot of sliding yoke and causes the slider to go back and forth.



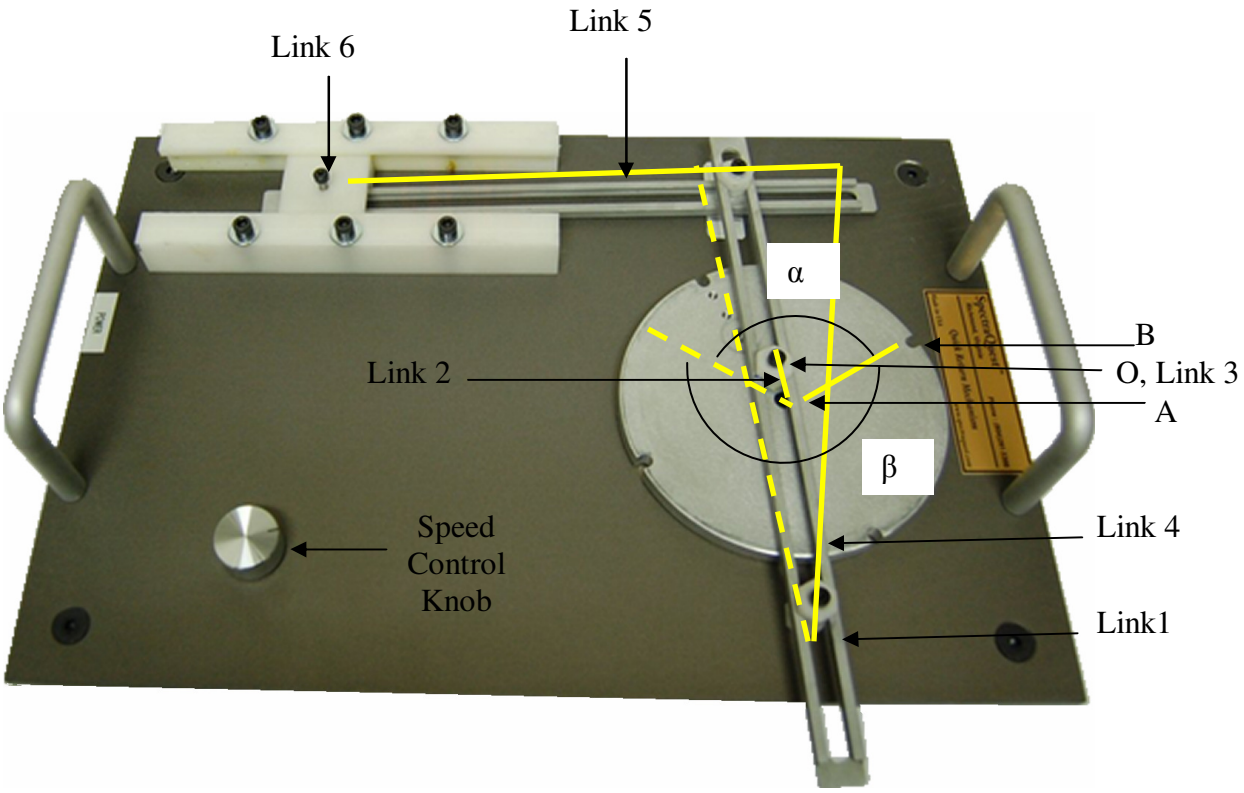
Universal Joint

A universal joint is used to transmit rotational motion from one shaft to another with fixed or varying angles of intersection of the shaft. The figure below shows a Cardan or Hooke universal joint. Here the plane of contact between the input and output member is not constant in space. The plane of contact oscillates back and forth and is alternately perpendicular to the two members. When the plane of contact does not remain constant in space, the universal joint is a non constant velocity joint. The figure below shows two universal joints connected together.



Slider Crank Quick Return Mechanism

Slider crank Quick return mechanism is used to convert linear to rotary motion or vice versa. It is also used in applications requiring different forward and return stroke velocities. The crank slider quick return mechanism is used in metal shaper machines where the forward stroke is slow cutting stroke and the return stroke is fast idle stroke (no work is done by the tool). Large time ratio can be obtained using slider crank quick return mechanism. By moving the pivot "O" along the line AB, desired time ratio (α/β), between the forward and return stroke can be achieved.

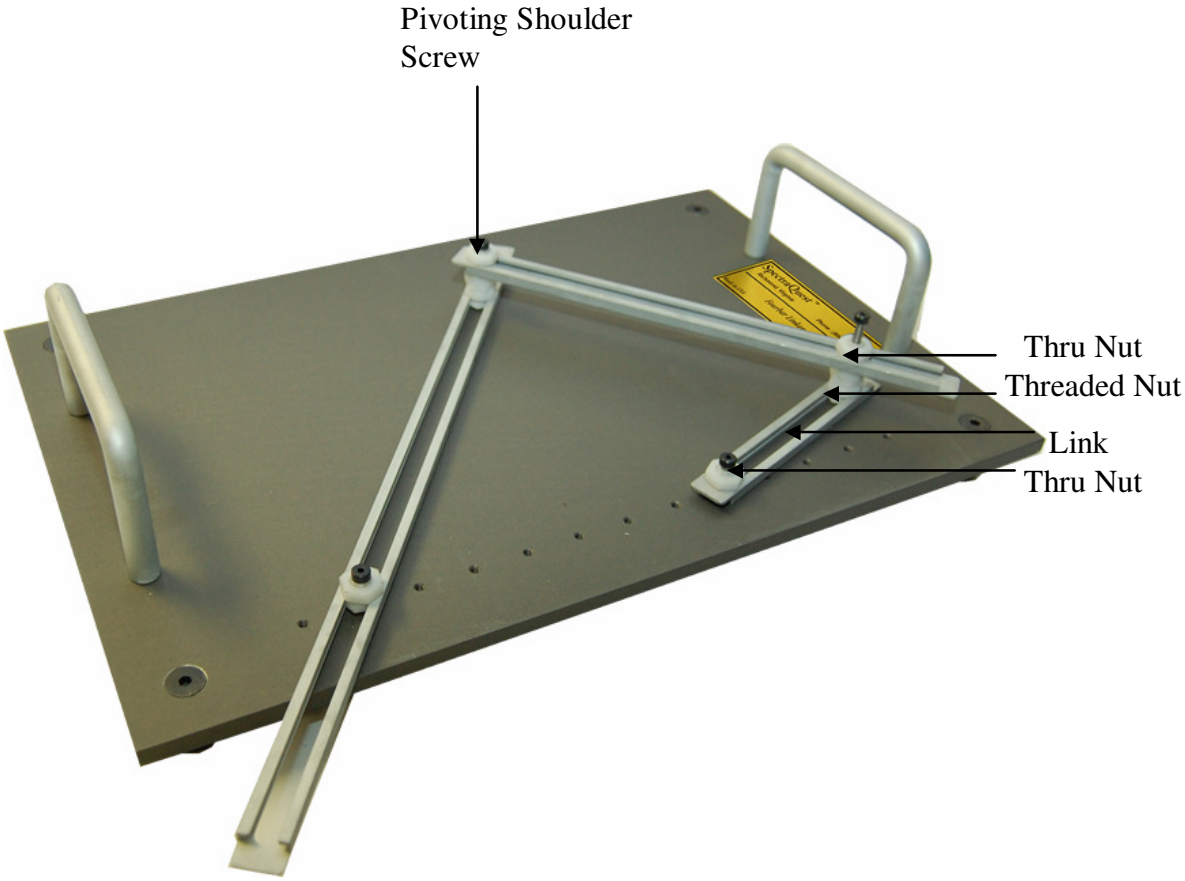


Four Bar Linkage

Four bar linkage consists of four pin connected links and is widely used for generating irregular motion. The length of each link is defined by the distance between the axes of its pin joints. The length of the different links determines the rotational behavior of the four bar linkage. This behavior is predicted by using the Grashof condition which is a relationship based on the link lengths.

The Grashof criterion is divided into three classes. All three classes of linkages can be obtained using the SpectraQuest device. Within each class different inversions can be

obtained by grounding different links. In class I, when the any one of the link adjacent to the shortest link is grounded, the shortest link will rotate fully and the link pivoted to the ground oscillates. When the shortest link is grounded, the motion is double crank. The links pivoted to the ground makes complete revolutions.



The figure above shows the four bar linkage apparatus. The nuts can be loosened and slid along the links. Different four bar linkage inversions can be obtained by changing the link length (by installing the nuts at different positions of the link).

Cam

A cam is an element that compels the movement of another element, follower by direct contact. A cam is classified according to its shape and a follower is classified either according to its motion or the nature of its surface in contact. The Figure 0 2: Cam Apparatus shows 3-4-5 polynomial cam with roller follower. A Cam-follower is designed based on the displacement – the distance through which the follower is moved for one revolution of the cam, velocity – the speed with which the cam moves the follower, acceleration – the rate of change velocity of the follower and jerk – the rate of change of acceleration.