

Subject Name - Basic Mechanical Engineering

Subject code - MEE105B

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### Experiment No-2

\* Name of the Experiment → Demonstration and working of slider cranks mechanism.

\* Aim → To study the working principle and construction of slider crank mechanism.

\* objective → To understand the working of slider crank mechanism and its inversions.

## Summary

### \* Slider-Crank Mechanism.

Slider-crank mechanism is an arrangement of mechanical parts designed to convert straight line motion into rotary motion, as in a reciprocating engine. It is used to convert rotary motion to straight line motion as in a reciprocating pump. Slider-crank mechanism is used to transform rotational motion into translational motion by means of a rotating driving beam, a connection rod and a sliding body.

### \* Links and joints

A mechanical linkage is an assembly of bodies connected to manage forces and movement. The movement of a body or link is studied using geometry so the link is considered to be rigid.

The connections between links are modelled as providing ideal movement, pure rotation or sliding and are called joints.

A linkage modelled as a network of rigid links and ideal joints is called a kinematic chain.

## \* Kinematic link:

Each part of a machine that undergoes relative motion with respect to some other part, is called kinematic link. Kinematic links help in the transmission of motion, from one machine part to another. Kinematic links form the backbone of any mechanical system.

### • Types of kinematic links -

- ① Rigid link
- ② Flexible link
- ③ Fluid link.

## \* Kinematic Pair:

A Kinematic pair or simply a pair is a joint of two links having relative motion between them.

### \* Kinematic pair according to nature of contact -

#### a) Lower pair -

A pair of links having surfaces or area contact between the members is known as a lower pair. The contact surfaces of the two links are similar.

Eg - Nut turning on a screw, shaft rotating in a bearing, all pairs of a slider-crank mechanism, universal joint etc.

b) Higher pair -

When a pair has appointed orline contact between the links, it is known as higher pair. The contact surfaces of the two links are dissimilar.

Eg - wheel rolling on a surface, cam and follower pair, tooth gears, balls and roller bearings, etc.

\* Kinematic pairs according to Nature of relative motion -

a) Sliding pair -

If two links have a sliding motion relative to each other, they form a sliding pair. A rectangular rod in a prism is a sliding pair.

b) Turning pair -

When one link has a turning or revolving motion relative to each other, they constitute a turning pair or revolving pair. In slider - crank mechanism, all pairs except the slider and guide pair are turning pairs. A circular shaft revolving inside a bearing is a turning-pair.

c) Rolling pair:-

When the links of a pair have a rolling motion relative to each other, they form a rolling pair, e.g. a rolling wheel on a flat surface, ball and roller bearing.

### d) Screw pair -

If two mating links have turning as well as sliding motion between them, they form a screw pair. This is achieved by cutting matching threads on the two links. The lead screw and the nut of a lathe is a screw pair.

### e) Spherical pair -

When one link in the form of a sphere turns inside a fixed link, it's spherical pair. The ball and socket joint is a spherical pair.

## \* Applications -

- Mechanisms obtained by fixing different links of slider crank chain are as follows -

### i) First inversion -

This inversion is obtained when link 1 (ground body) is fixed. Application - Reciprocating engine, reciprocating compressor etc

### ii) Second inversion -

This inversion is obtained when link 2 (crank) is fixed. Application - Whitworth quick return mechanism, Rotary engine, etc.

### 3) Third inversion -

This inversion is obtained when link 3 (connecting rod) is fixed. Application - slotter crank mechanism, oscillatory engine etc..

### 4) Fourth inversion -

This inversion is obtained when link 4 (slider) is fixed. Application - Hand pump, pendulum pump or Bull engine, etc. revolver mechanisms.

### \* Conclusion -

The dynamic behavior of a slider-crank mechanism with a flexible connecting rod is investigated. Slider-crank mechanism converts rotary motion into reciprocating motion by means of a rotating driving beam, a connection rod & sliding body. The use of this mechanism in the wide range of machines like pumps and compressors is observed.

## Questions

(Q1) Define Kinematic link, Kinematic pair, Kinematic chain and mechanism.

Ans → • Kinematic link -

Each part of a machine that undergoes relative motion with respect to some other part is called Kinematic link. Kinematic links help in the transmission of motion, from one machine part to another.

• Kinematic pair -

A kinematic pair or simply a pair is a joint of two links having relative motion between them.

• Kinematic chain -

A linkage modelled as a network of rigid links and ideal joints is called a kinematic chain.

• Mechanism

When one of the links of a kinematic chain is fixed, the chain is known as mechanism which may be used for transmitting or transforming motion.

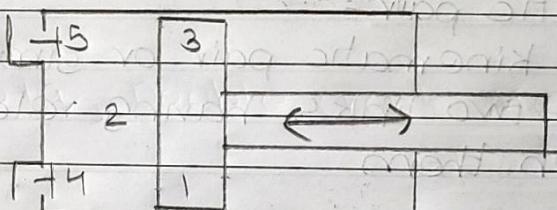
(82) what are the various inversions of slider crank mechanism? Give example each with neat sketch.

Ans → Mechanisms obtained by fixing different links of slider crank chain are as follows-

### ① First inversion -

This inversion is obtained when link 1 (ground body) is fixed.

Application - Reciprocating engine, Reciprocating compressor etc.

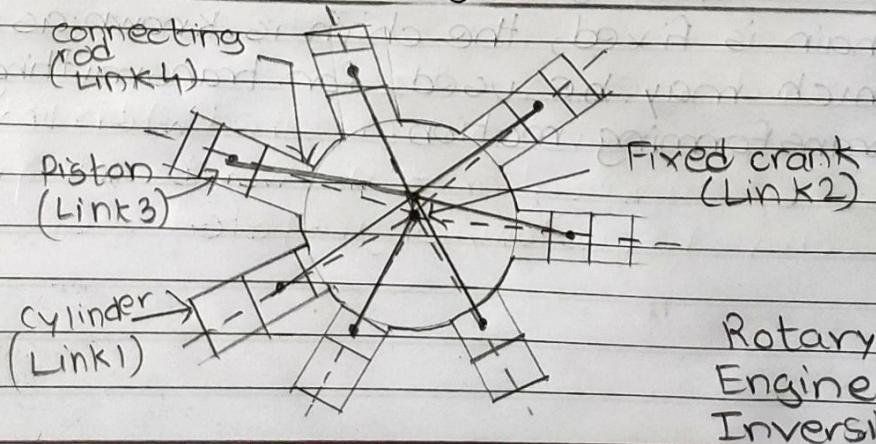


Reciprocating compressor function.

### ② Second inversion -

This inversion is obtained when link 2 (crank) is fixed.

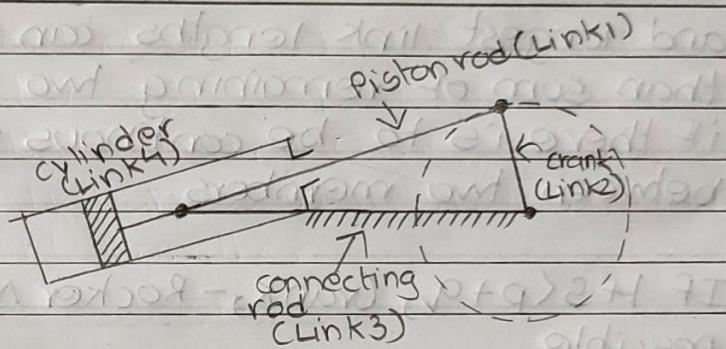
Application - Whitworth quick return mechanism, Rotary engine, etc.



### ③ Third inversion -

This inversion is obtained when link 3 (connecting rod) is fixed.

Application - slotted crank mechanism, oscillatory engine etc.

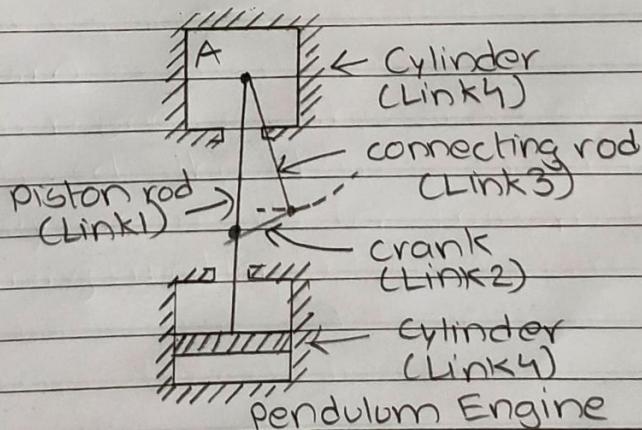


Oscillatory engine

### ④ Fourth inversion -

This inversion is obtained when link 4 (slider) is fixed.

Application - Hand pump, pendulum pump or Bell engine, etc. revolver mechanisms.



(Q3) what are various inversions of Grashof's Four bar chain mechanism?

Ans → In Grashof's Four bar mechanism;

- For Planner Four bar linkage, sum of shortest and longest link lengths can not be greater than sum of remaining two link lengths, if there is to be continuous relative motion between two members.
- If  $l + s < p + q$ , Crank, - Rocker Mechanism is possible.
- If  $l + s = p + q$ , Double crank Mechanism is possible.
- If  $l + s > p + q$ , Double Rocker Mechanism is possible.