# MACHINES AND MECHANISMS
# TYBTECH (MECHANCIAL ENGINEERING)

## Lab Experiment No. 1

**AIM: -** To study of all inversions of four-bar mechanisms, Single & double slider Crank mechanisms, using models.

**APPARATUS USED**: - Models of four-Bar Mechanisms, Single & Double slider crank mechanisms.

**THEORY:-**

1. Definitions of four- Bar Mechanisms, Single & Double slider crank mechanisms.
2. Classifications of four- Bar Mechanisms, Single & Double slider crank mechanisms.
3. Diagrams of four- Bar Mechanisms, Single & Double slider crank mechanisms.
4. Working & Construction of four- Bar Mechanisms, Single & Double slider crank mechanisms.
5. Applications of four- Bar Mechanisms, Single & Double slider crank mechanisms.

**FOUR BAR MECHANISM: -** A four bar link mechanism or linkage is the most fundamental of the plane kinematics linkages. It is a much preferred mechanical device for the mechanization and control of motion due to its simplicity and versatility. Basically it consists of four rigid links which are connected in the form of a quadrilateral by four pin joints. A link that makes complete revolutions is the crank, the link opposite to the fixed link is the coupler and the fourth link a lever or rocker if oscillates or an another crank, if rotate.

By fixing the link:-

- Shortest Link Fixed.
- Link opposite to Shortest Link fixed.

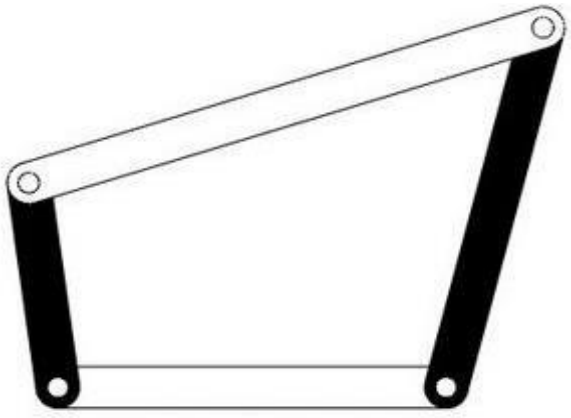


**Figure 2.1** Four bar mechanism

**Inversions of 4-Bar Chain**

1. Double Crank mechanism
2. Crank-Rocker or Rocker Crank Mechanism
3. Double Rocker Mechanism

**Examples of Inversions of 4-Bar chain**

**Double Crank Mechanism (Coupling Rod of Locomotive)**

In this mechanism, the links AB and DC acts as cranks and are connected to the respective wheels. The link BC acting as a coupling rod and the link AD is a fixed link in order to maintain constant centre to centre distance between them. This mechanism is meant for transmitting rotary motion from one wheel to another wheel.

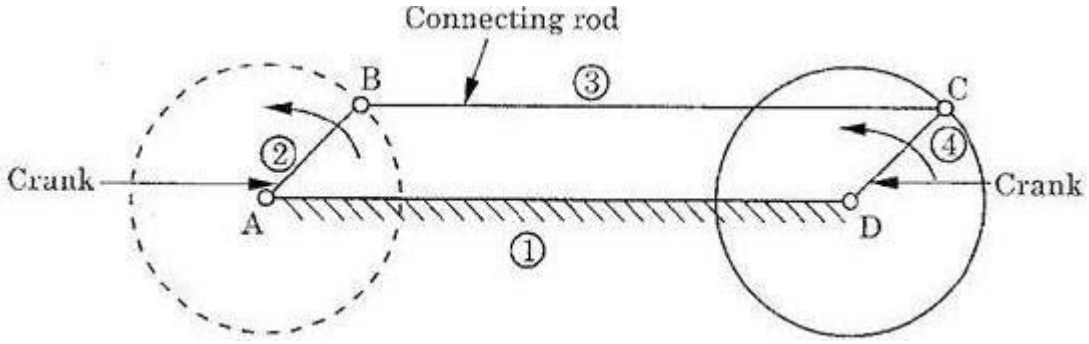



**Figure 2.2(a)** Locomotive Coupler

**Beam Engine (Crank-Rocker or Rocker-Crank)**

A part of the mechanism of a beam engine (also known as crank and lever mechanism) which consist of four links. In this mechanism when the crank rotates about the fixed centre A, the lever oscillates about the fixed centre D.

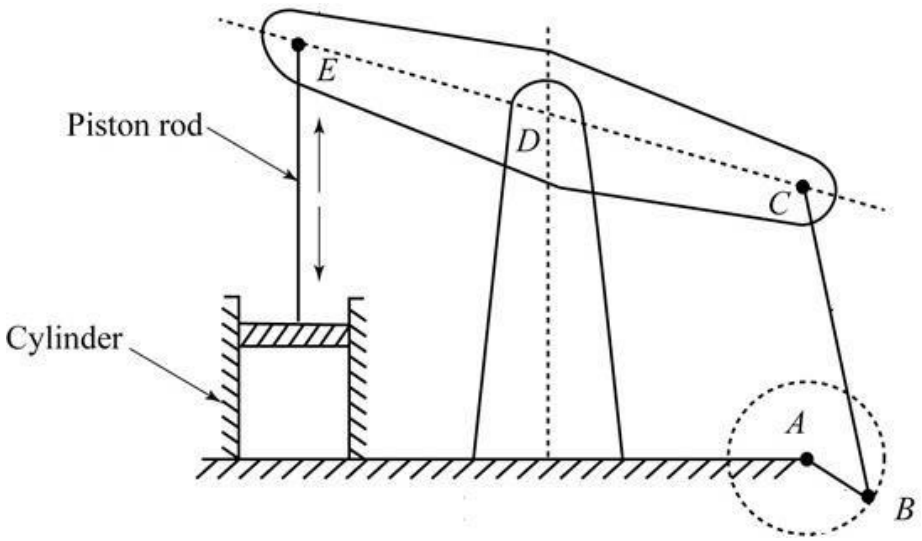



**Figure 2.3(b)** Beam Engine

**Watt's mechanism (Double Rocker Mechanism)**

It is a crossed four bar chain mechanism and was used by watt for the early steam engines to guide the piston rod in a cylinder to have an approximate straight-line motion.

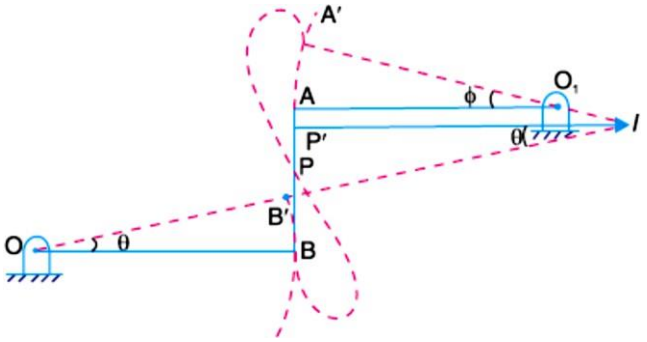



**Figure 2.2(c)** Watt's mechanism

**INVERSIONS OF SINGLE SLIDER–CRANK CHAIN:-**

Different mechanisms obtained by fixing different links of a kinematics chain are known as its inversions.

A slider –crank chain has the following inversions:-

1. First inversion (i.e.; Reciprocating engine and compressor) – this inversion is obtained when link 1 is fixed and links 2 and 4 are made the crank and the slider respectively.

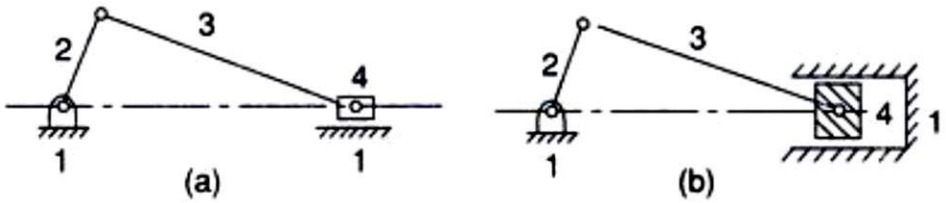



**Figure 2.3** Mechanism used in **(a)** Reciprocating engine; **(b)** Reciprocating compressor

a) Second inversion (i.e., Whitworth quick return mechanism and Rotary engine) – fixing of link 2 of a slider – crank chain.

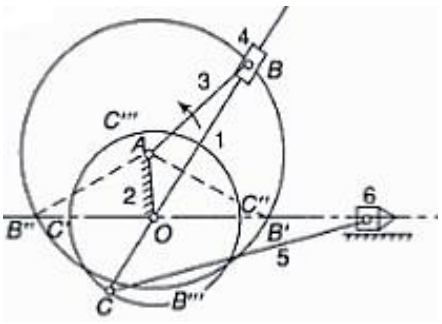



**Figure 2.4(a)** Whitworth quick return mechanism

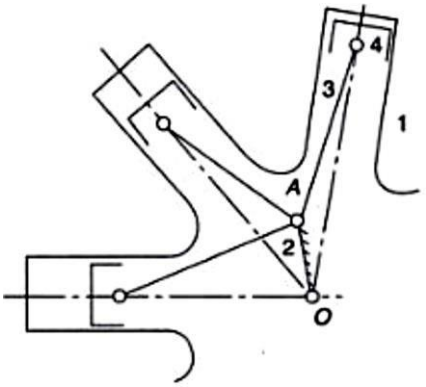
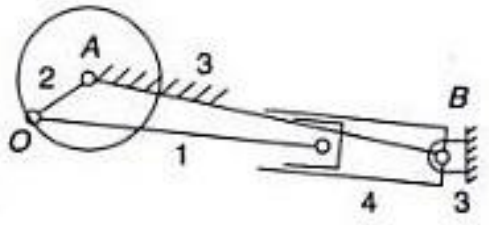
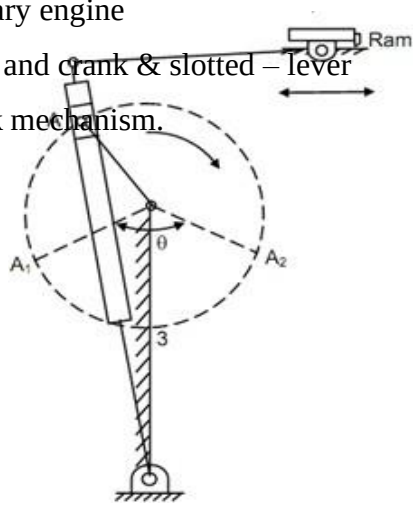



**Figure 2.4(b)** Rotary engine

b) Third inversion (i.e., Oscillating cylinder engine and crank & slotted – lever mechanism) - By fixing link 3 of the slider crank mechanism.




**(a)** **(b)**

**Figure 2.5(a)** Oscillating cylinder engine **(b)** Slotted – lever mechanism

c) Fourth inversion (Hand pump) – if link 4 of the slider crank mechanism is fixed, the fourth inversion is obtained.

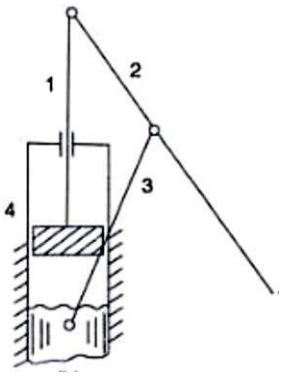



**Figure 2.6** Hand pump

**DOUBLE-SLIDER CRANK-CHAIN:**

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A four-bar chain having two turning and two sliding pairs such that two pairs of the same kind are Adjacent is known as a double-slider-crank chain. The following are its inversions:

1. First inversion (i.e., Elliptical trammel) Link 1 is Fixed

   It is an instrument used for drawing ellipses. This inversion is obtained by fixing the slotted plate

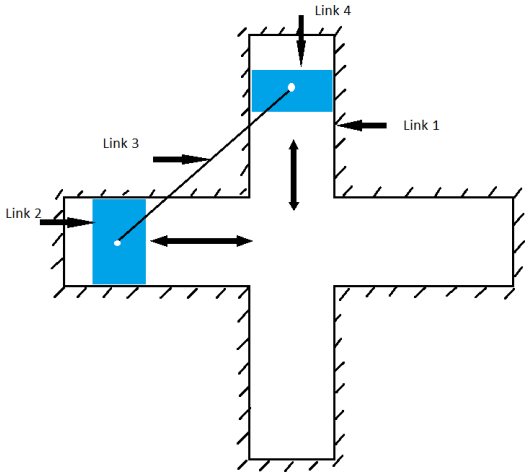


**Figure 2.7(a)** Elliptical trammel

2. Second inversion (i.e., Scotch yoke): Any of the slider is fixed (i.e. link 2 or link 4) This mechanism is used for converting rotary motion into a reciprocating motion. The inversion is obtained by fixing either the link 2 or link 4. In Fig., link 2 is fixed. In this mechanism, when the link 3 (which corresponds to crank) rotates, the link 1 (which corresponds to a frame) reciprocates. The fixed link 2 guides the frame.

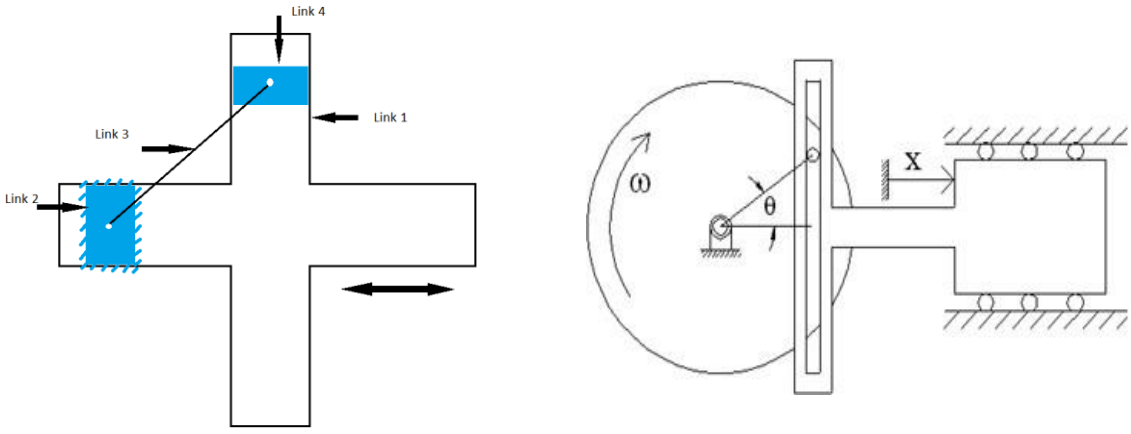


**Figure 2.7(b)** Scotch yoke

3. Third inversion (i.e., Actual Oldham's coupling): Link 3 is fixed

   An oldham's coupling is used for connecting two parallel shafts whose axes are at a

small distance apart. The shafts are coupled in such a way that if one shaft rotates, the other shaft also rotates at the same speed. This inversion is obtained by fixing the link 3

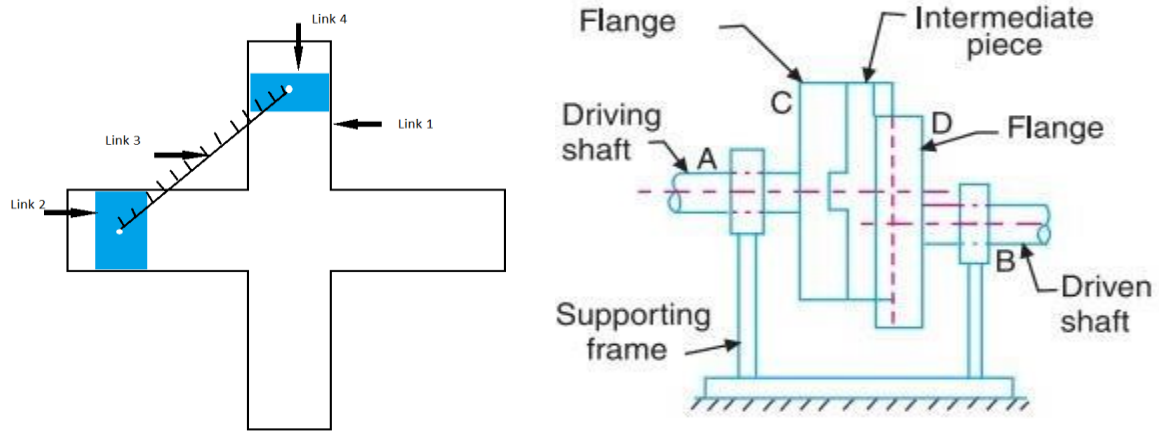


**Figure 2.7(c)** Oldham's coupling

**OBSERVATION & CONCLUSION:**

1. Comparison between 4 Bar, Single & Double slider cranks mechanisms.
2. Type of Motion to be named.

**APPLICATIONS:**

1. In reciprocating engine.
2. In reciprocating compressor.
3. In Whitworth quick – return mechanism and Rotary engine.
4. In oscillating cylinder engine and crank & slotted-lever mechanism.
5. In hand pump.
6. In scotch yoke.

**VIVA-QUESTIONS:**

1. What are the inversions of four bar mechanism & give their applications?
2. What are the Inversions of single slider crank mechanism & give their application?
3. What are the of Inversions of Double slider crank mechanism & give their applications?
4. Define degree of freedom & give examples?
5. Define Kutzbach & Grubler's criterian.