# Design and Technology Notes for 7059/1 and 7055/1

#### Topic on Mechanisms

Foreword;

This is a collaborative effort due to the pertinent lack of DnT notes in the online space, headed by Tino (+65 8933 9390) and Wei En (+65 9752 6078) of Beatty Secondary, whom is contactable if necessary.

- 1) <u>Input</u> movement into system
- Process conversion of INPUT to OUTPUT
- <u>Output</u> resultant converted moment
- 2) <u>Feedback</u>; The output is fed back to the input, on which depending on the output, the input is adjusted to achieve a desired result.
- Open-loop Control System



- An open-loop system has no feedback, so it cannot respond to environmental changes.
- <u>Closed-loop Control System</u>



- A closed loop system is able to respond to environmental changes using feedback from within the system.
- 3) Types of motion

OSCILLATING LINEAR ROTARY RECIPROCATING



## 4) Functions of mechanisms

Conversion of motion; Changing of one type of motion to another.

Transmission of motion; Changing the place of movement.

<u>Control of motion</u>; Controlling the speed, amount of force, direction, and distance of movement.

- 5) Mechanical Advantage
- Mechanisms are often used to allow a small effort to move a large load.
- Mechanical advantage is the ratio between the output force and the input force
- Calculated as Mechanical Advantage =  $\frac{Output Force}{Input Force}$
- If the mechanical advantage > 1, output force will be larger than the input force.
- 6) <u>Types of mechanisms</u>

6a) Levers



- <u>First class lever</u> the fulcrum is in the middle of the effort and the load.
- <u>Second class lever</u> the load is in the middle between the fulcrum and the effort.
- <u>Third class lever</u> the effort is in the middle between the fulcrum and the load.

## 6b) Linkages

- Made by connected levers together.
- Able to turn a small force into a large pushing force

## <u>Four-bar linkage</u>

Consists of 4 connected links. Different movements can be achieved by changing the lengths of the links.

Can be used to convert motion from:

- One type to another; one speed to another
- One size to another; and

- One axis to another

### 6c) <u>Pulleys</u>

A pulley is a wheel on a axis or shaft. Pulleys are used to lift loads, transmit motion, and transmit power.

- There are 2 types of pulleys; **simple** and **compound** pulley system.

A <u>simple pulley</u> uses only one pulley; The fixed pulley is attached to a stationary object like a wall or ceiling.

A movable pulley moves up or down with the effort.

A <u>compound pulley</u> is a combination of fixed and movable pulleys. The pulleys are mounted on the fixed and moving axles.



Pulleys are connected with rubber belts to transmit power from a motor to other working parts. They can be connected in either <u>open drive or closed</u> <u>drive.</u>



**Advantage;** Belts are simple and inexpensive. They run smoothly with little noise and vibration. They need no lubrication and require minimal maintenance.

**Disadvantage;** Belts may slip and stretch, resulting in lowered efficiency. **Application;** Washing machines for the purpose of transmitting movement from motor to drum.

#### 6d) Pulley and Belt systems

; They use friction between the belt and pulley to transmit power.

Name	Advantages	Disadvantages	Application	Visual representation
Flat Belt	Simple, inexpensive, suitable for high speed	Slippage can occur when overloaded. Tends to be bulky; unable to transmit large loads.	Conveyor belts	
Vee Belt	Less slippage/alignment problems. Provides optimal combination of traction and speed o/ movement.	Difficult to fit into position.	Washing machines	
Timing belts	Configuration has no slippage	More expensive due to complexity of construction.	Automobiles	Image: state span Im

Step pulley	Different speed can be produced by changing the belt to the different pairs of pulleys.	-	Drilling machines	$N_{d} = 120$
Chain and sprocket	Stronger, will not slip.	It is noisier; requires lubrication.	Bicycles	

6e) Cams

- Cams are a specially designed and shaped material which rotates.

Pear	Snail	Eccentric	Ellipse
PEAR SHAPED CAM SLIDE By VRyon FLAT FOLLOWER CENTRE OF ROTATION	FOLLOWER SLIDE ROLLER PEAK SNAIL/DROP CAM VERTICAL CENTRE LINE	ECCENTRIC CAM	

#### Applications of Cams

Cam brake	Telescopic fastener	Cam lock	Window cam lock
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- A follower is a mechanism which is designed to move as it follows the edge of the cam.
- A cam and follower mechanism converts circular motion to reciprocating motion.
- A cam and lever mechanism converts circular motion to oscillating motion.





Cam-and-lever

Rotary motion to oscillatory motion

6f) <u>Gears</u>

## Gears are wheels with evenly-sized and spaced teeth.

Gears are used to;

- Control speed
- Changing direction of motion
- Increase turning force

#### **Types of Gears**







Helical Gear



Bevel Gear

Spur Gear



**Rack & Pinion Gear** 

Worm Gears 6g) <u>Cranks</u>

- A crank is an arm attached at right angles to a rotating shaft.
- Can be used as a handle
- Usually linked with other mechanical components.
- Used in bicycle pedals, sheet metal rollers, mechanical pencil sharpener.

#### 6h) Crank-and-slider

- Used to change rotary to reciprocal motion, and vice-versa.

#### 6i) Rack and pinion.

- Rack is the flat, toothed part.
- The pinion is the gear.



6j) Rachet and Pawl; Purpose is to allow a shaft to rotate in one direction only.



#### <u>6k) Screw</u>

- Used to convert rotary motion to linear motion
- Able to produce a large force.

#### 6l) Fasteners

- Screws and bolts are available with different types of heads



Set Screw	Cap Screw	Split Pins	Bolts, Nuts, and Washers
A CONTRACTOR OF THE OWNER OWNER OF THE OWNER OWN			Bolt Head Hole Body Washer Nut Threads Parts to be Joined Joined