

# CAM MECHANISMS

ECCENTRIC

PEAR

SNAIL

HEART

CYLINDRICAL

FLAT

SWASH

BOX

PROFILE

FOLLOWER

DWELL

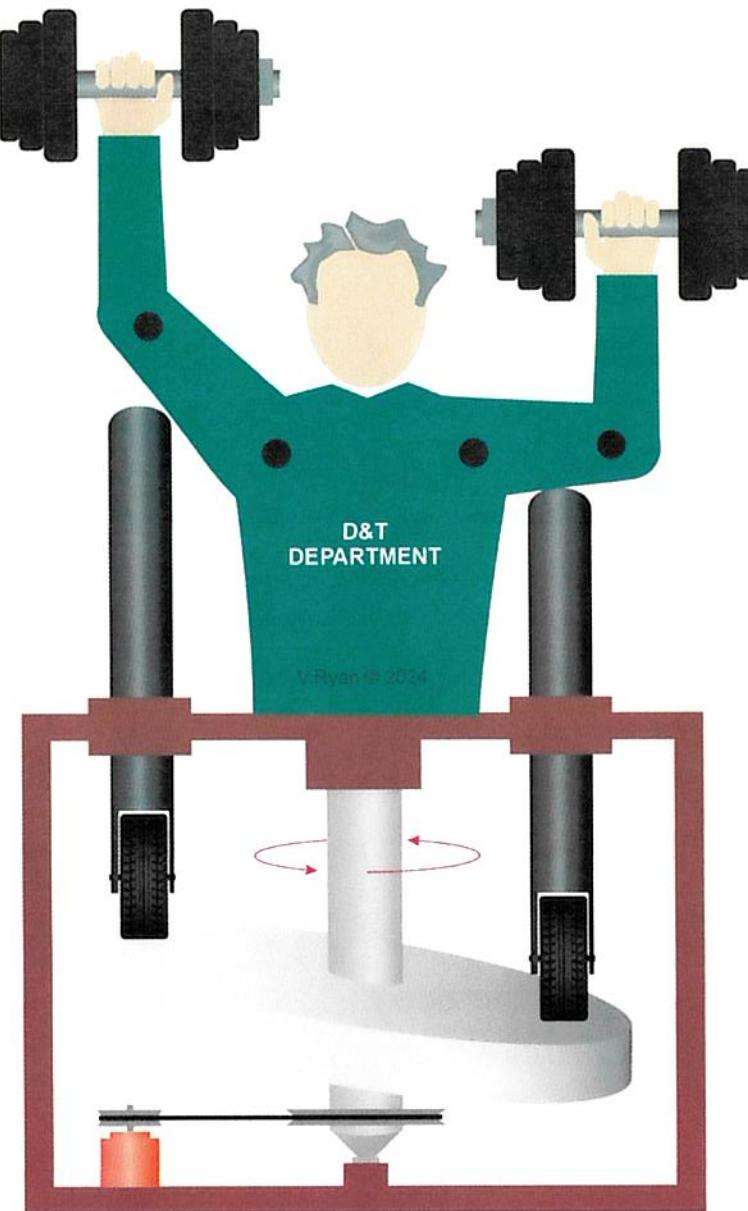
RISE

FALL

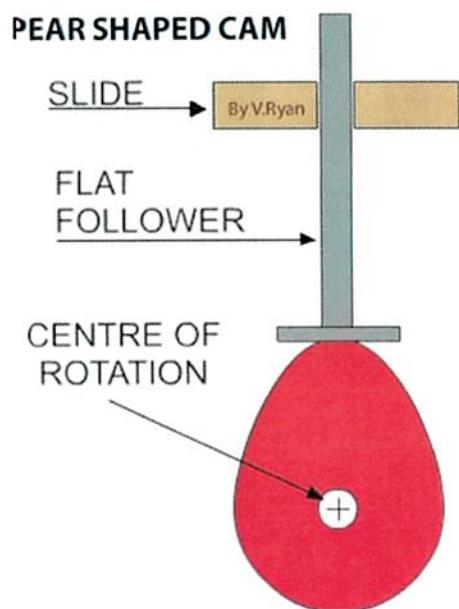
ROTATION

PIVOT

SLIDE



# A PEAR SHAPED CAM IS USED FOR THIS EXAMPLE



A CAM has two parts, the FOLLOWER and the CAM PROFILE. Diagrams one to six show a rotating cam pushing a follower up and then allowing it to slowly fall back down.

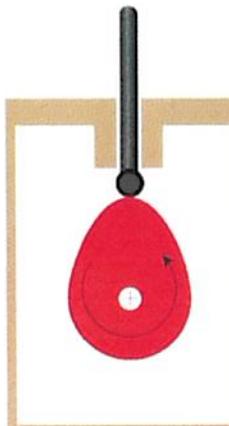
Diagram 1 shows the cam is in a vertical position. It slowly rotates in an anticlockwise direction.

As it rotates the follower drops down (diagram 2).

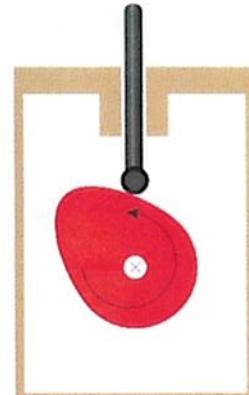
Diagrams 3 to 5 show no change in the height of the follower, called the 'dwell' (a characteristic of pear shaped cam profiles). The dwell is when the cam continues to rotate, but its shape means that there is no change in the position / height of the follower.

Diagram 6 shows the follower rising again.

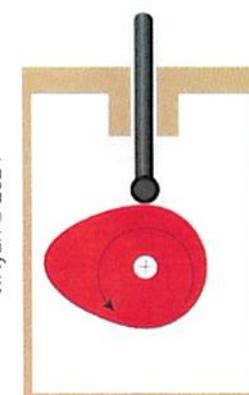
DIA. 1



DIA. 2



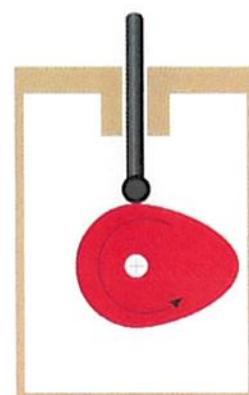
DIA. 3



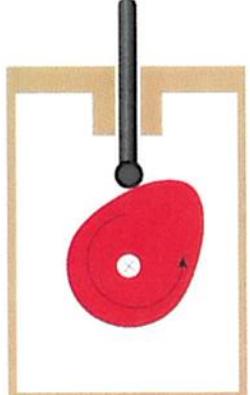
DIA. 4



DIA. 5



DIA. 6

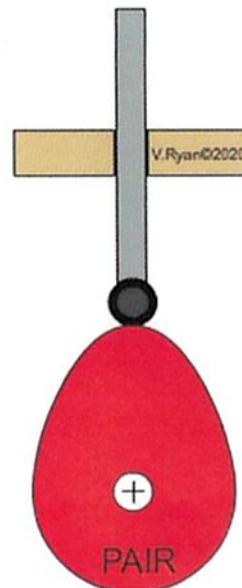


# COMMON CAM PROFILES

Cams can be shaped in any number of ways and this is determined by the way the follower is to move. The shape of the cam is called the PROFILE. Examples of various cam profiles can be seen below.

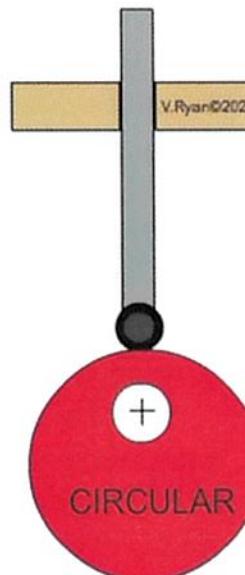
## PEAR

Pear shaped cams are used on the shafts of cars. The follower remains motionless for about half of the cycle of the cam and during the second half it rises and falls



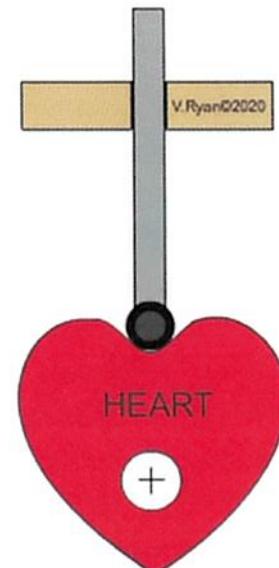
## CIRCULAR

Circular cams or eccentric cams produce a smooth motion. These cams are used in steam engines.



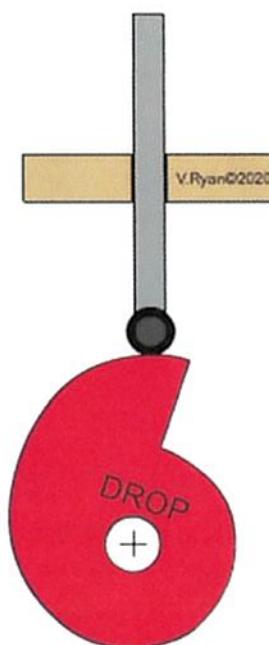
## HEART

Heart shaped cams allow the follower to rise and fall with 'uniform' velocity.



## DROP

What type of movement do you think this cam profile will give ?

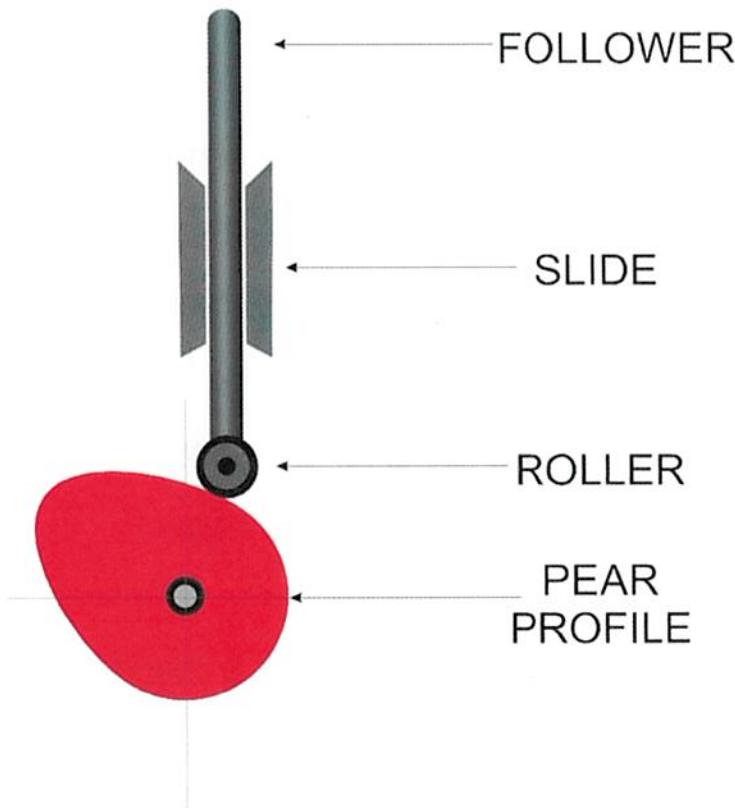
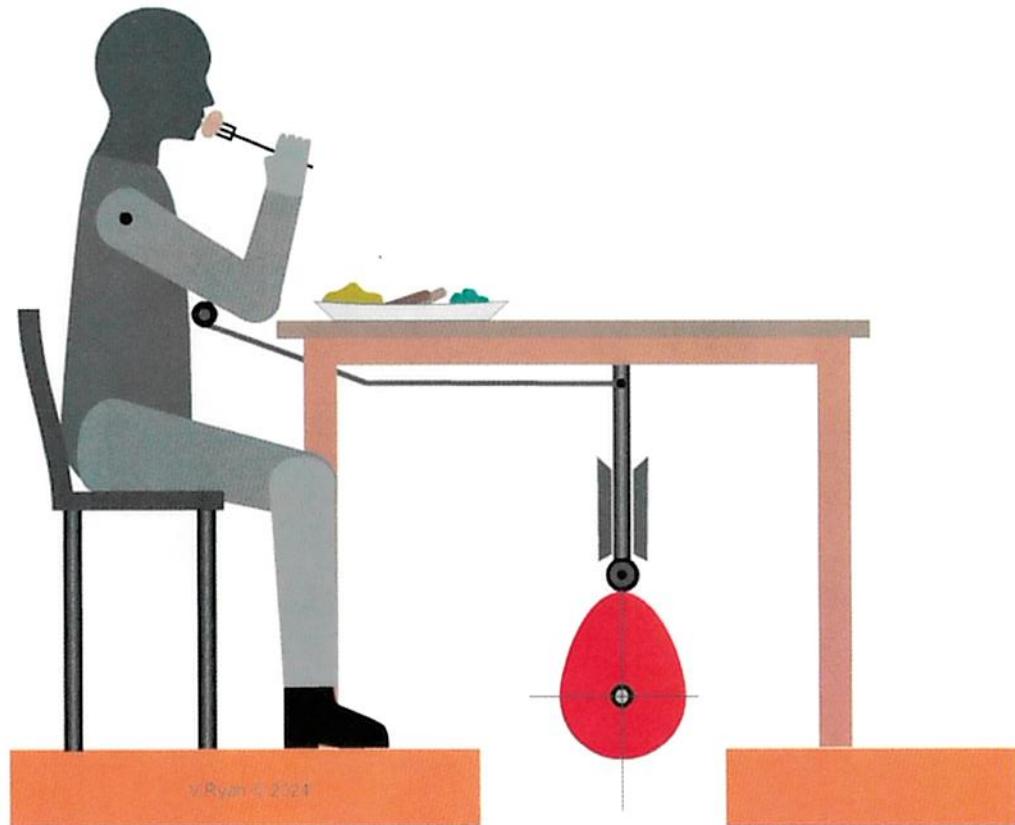


# THE PEAR SHAPED CAM

The toy is operated manually by turning a handle. This turns the cam profile, lifting the arm and food towards the 'models' mouth. Installing different cam profiles, gives a slightly different movement of the arm.

The pear shaped cam profile allows for a smoother action as the arm rises and falls. However, for half the rotation of the cam, the arm stays in the same place. The snail profile allows for a smooth rise and a quick / sudden drop of the arm.

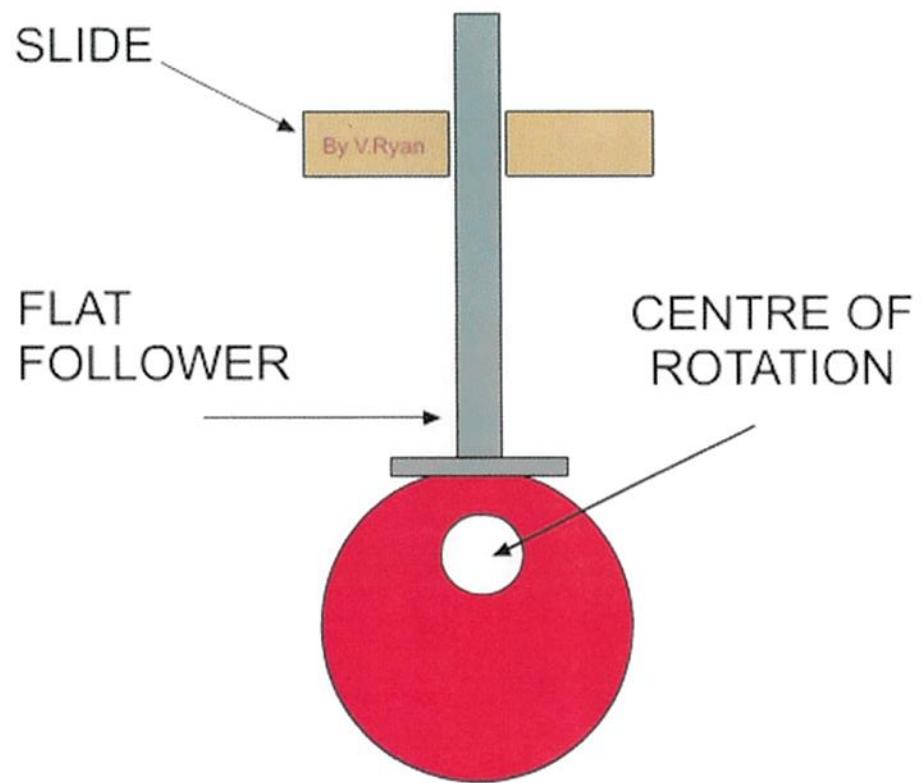
The advantage of a pear shaped cam, is that the handle can be rotated in both directions, because the arm lifts and falls smoothly. However, if a snail drop cam is fitted to the mechanism, the handle must be rotated in an anti-clockwise direction only. Otherwise it will 'jam'.



# ECCENTRIC CAM

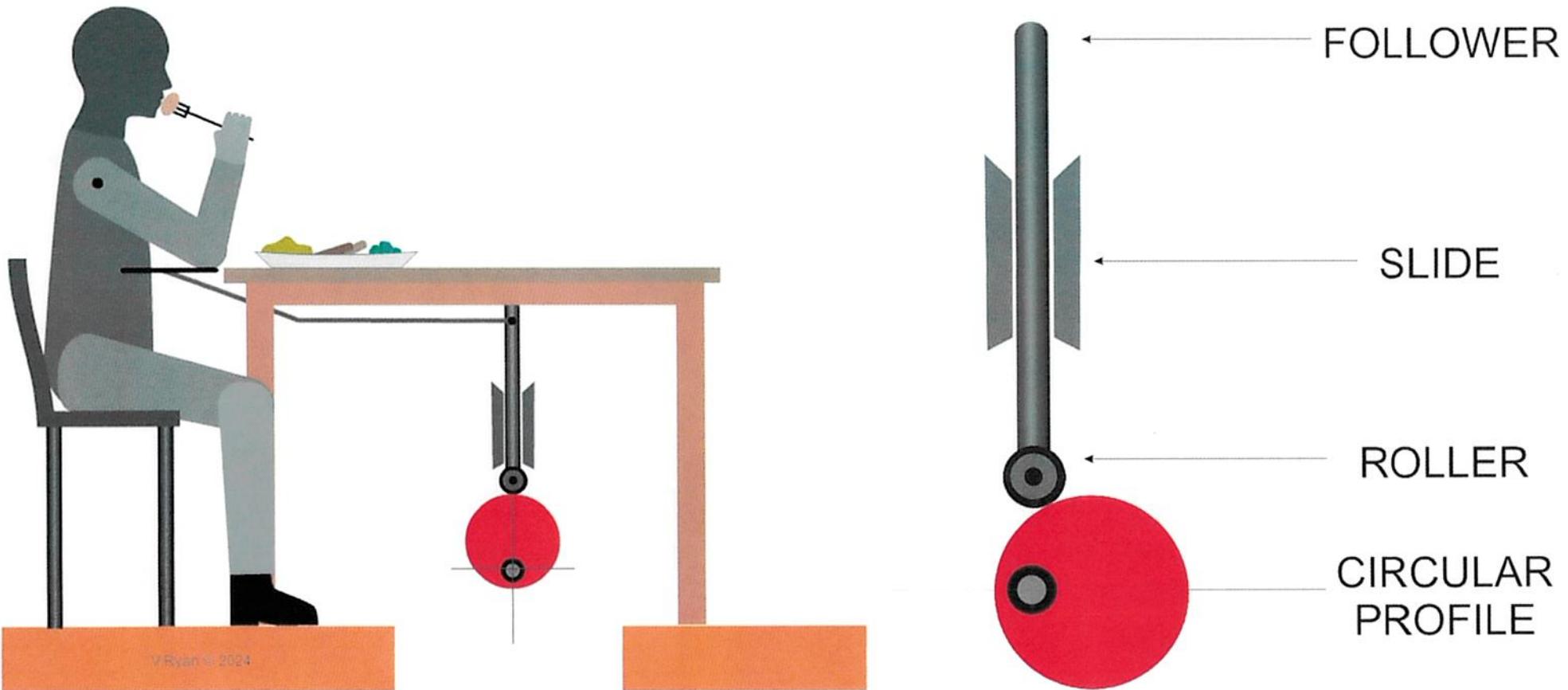
## ECCENTRIC CAM

An eccentric cam is a disc with its centre of rotation positioned off centre . This means as the cam rotates the flat follower rises and falls at a constant rate. This type of cam is the easiest to make and yet it is one of the most useful.



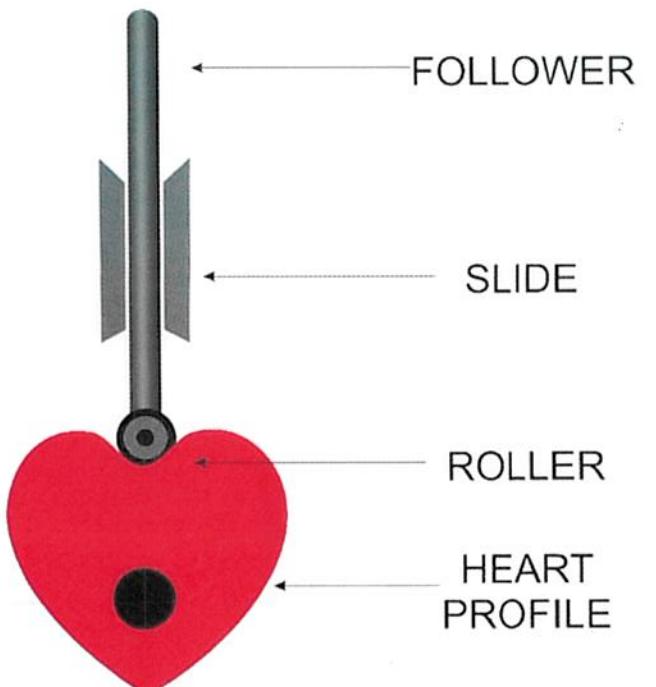
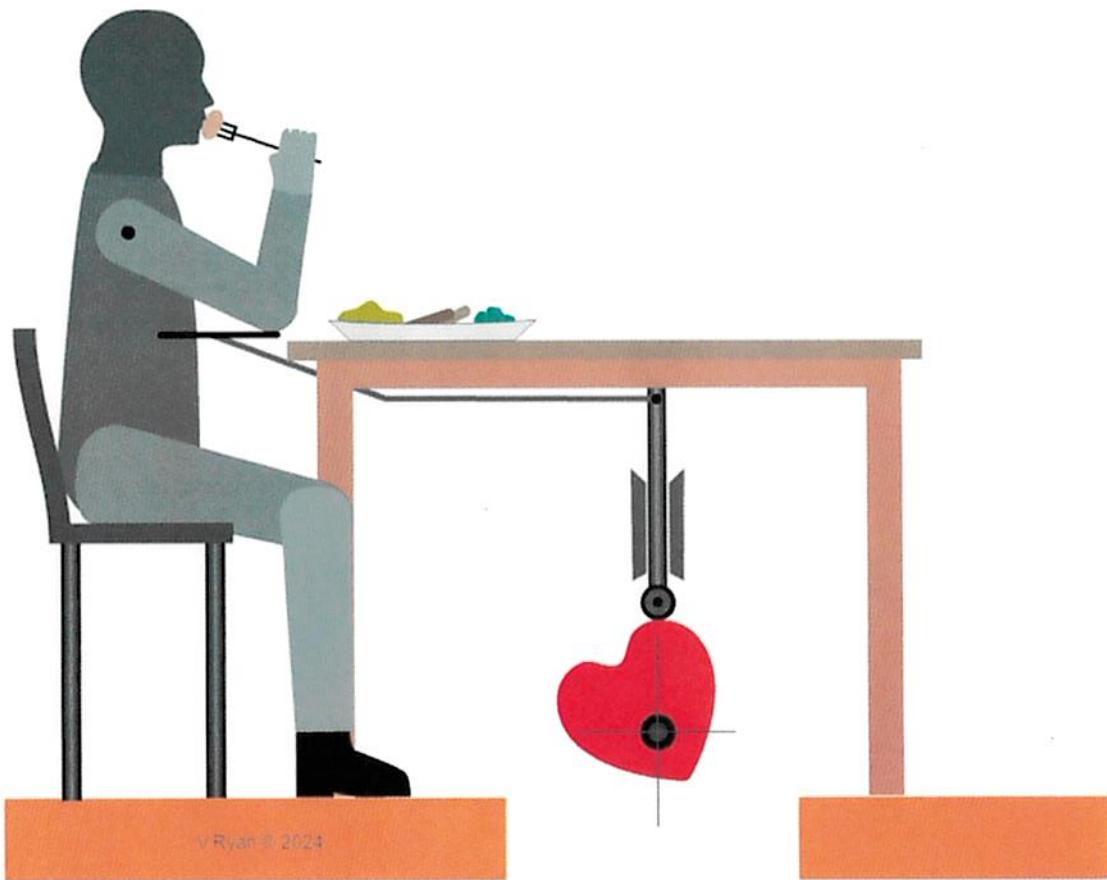
## PRACTICAL EXAMPLE - ECCENTRIC CAM

Below, the toy mechanism is using an offset circular cam profile (eccentric cam), means that alterations have to be made to the follower. The arm now rests on a 'flat' and the circular cam has been lowered. This cam gives a very smooth movement. This type of cam handles side forces really well.



# THE HEART SHAPED CAM

A heart-shaped cam profile looks like a heart. The cam mechanism driving the toy produces a steady rise and fall motion and uniform velocity. However, when applied to this mechanical toy, it does not give a suitable movement of the arm.



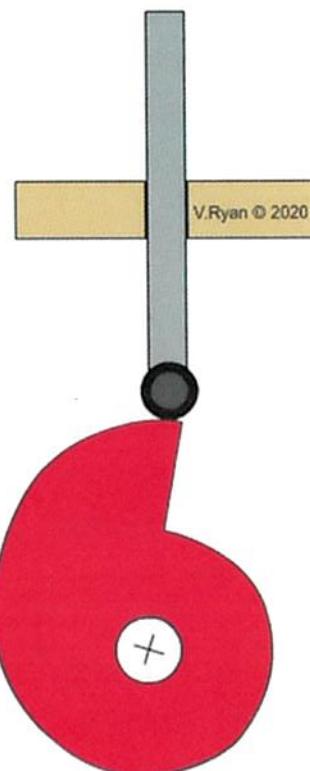
# WHAT HAPPENS WHEN A DROP CAM ROTATES IN THE WRONG DIRECTION?

Direction of rotation of the cam profile is very important, especially when a drop cam profile is being used.

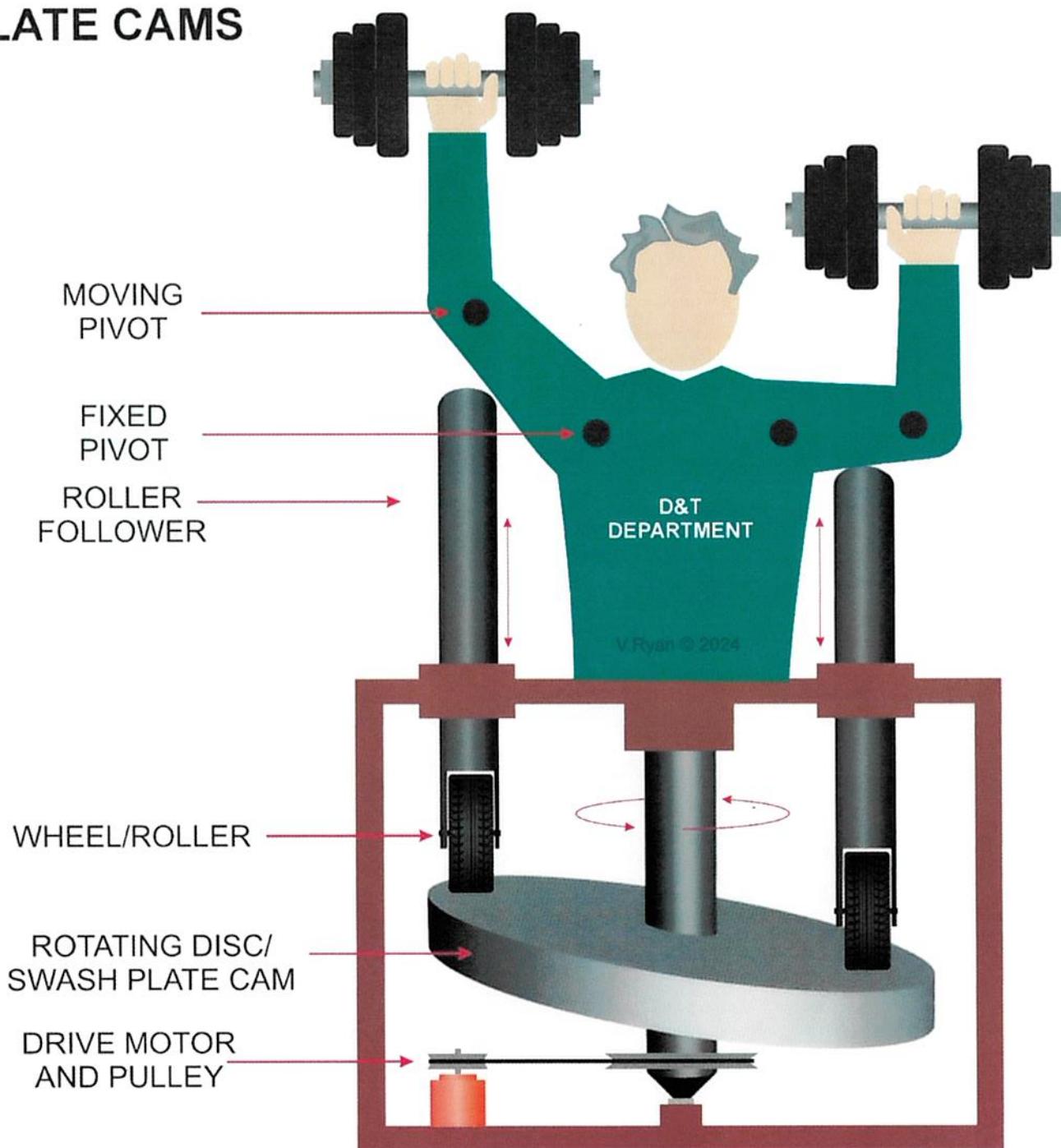
The example opposite shows what happens when this profile rotates in a clockwise direction.

The roller follower, 'jams' the mechanism. This will usually prevent the profile rotating any further and can even break or damage the mechanism.

DROP CAM ROTATING IN THE WRONG DIRECTION



# SWASH PLATE CAMS



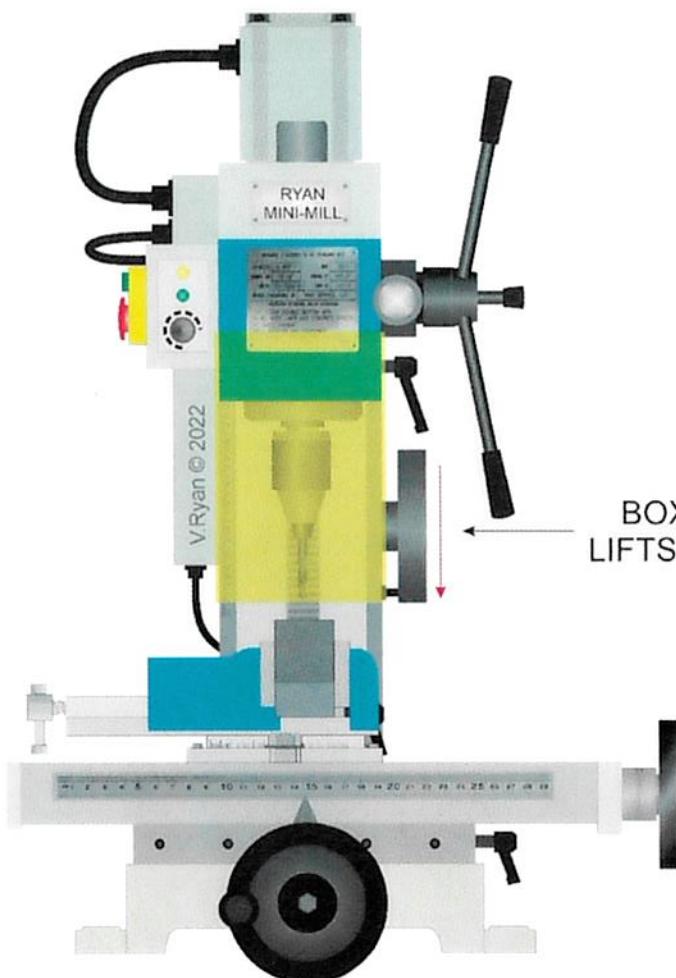
## BOX CAMS

A practical application of a box cam can be seen below. The machine drills holes in steel parts for car engines.

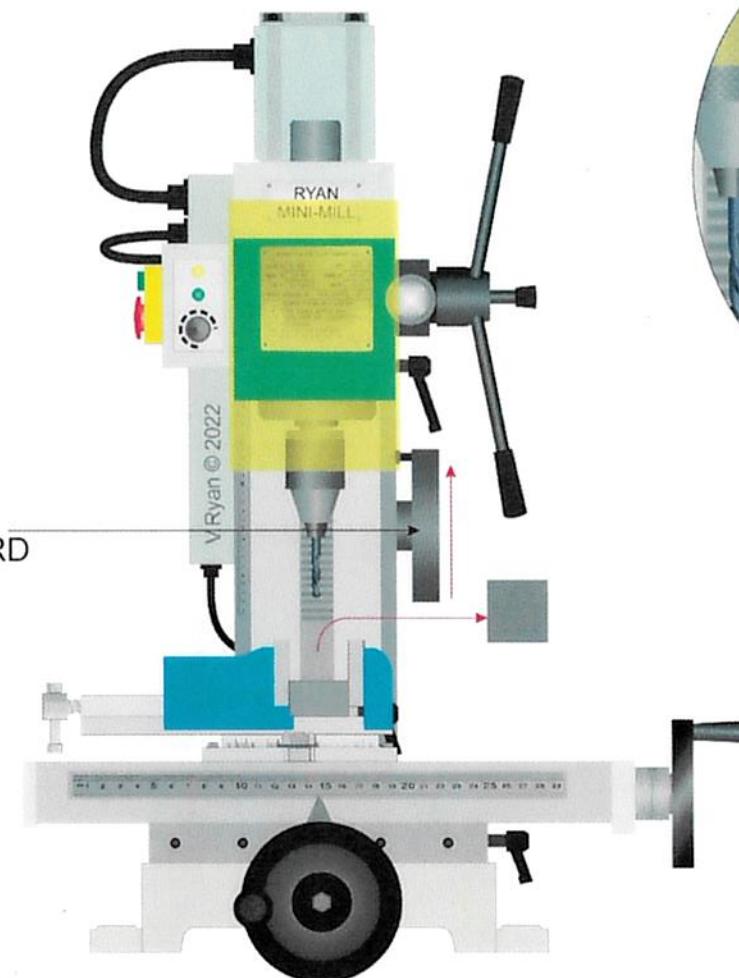
The box cam and follower automatically operates the guard.

The rotating box cam ensures that the follower lifts the guard after machining has taken place, so that a new part can be placed in the vice and drilled.

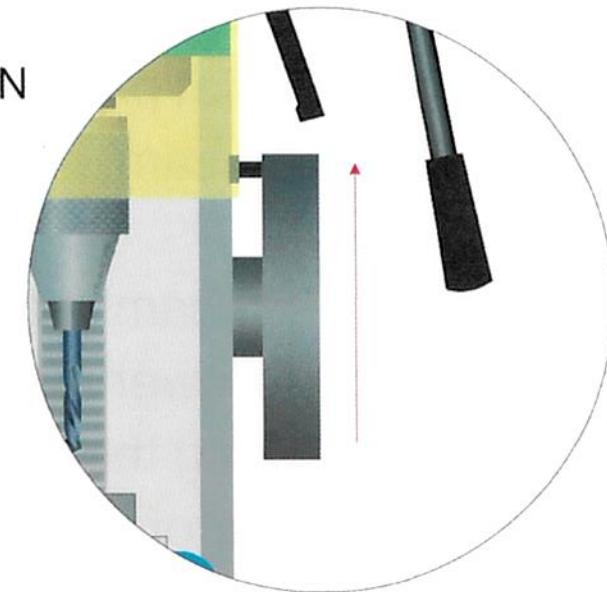
GUARD IN POSITION



GUARD LIFTED - OUT OF POSITION



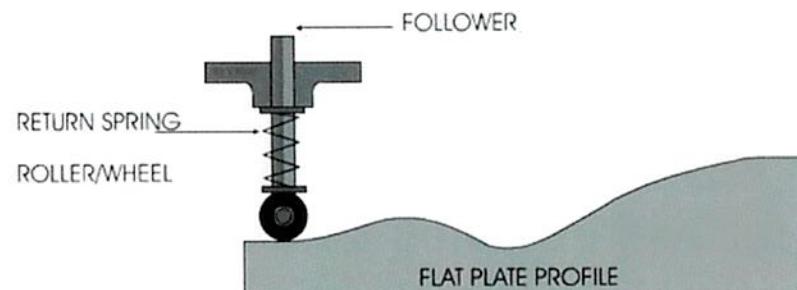
BOX CAM  
LIFTS GUARD



PLEASE NOTE THAT THE BOX CAM SHOWN HERE, IS DESIGNED TO MOVE THE FOLLOWER QUITE A DISTANCE, OPENING AND SHUTTING THE GUARD.

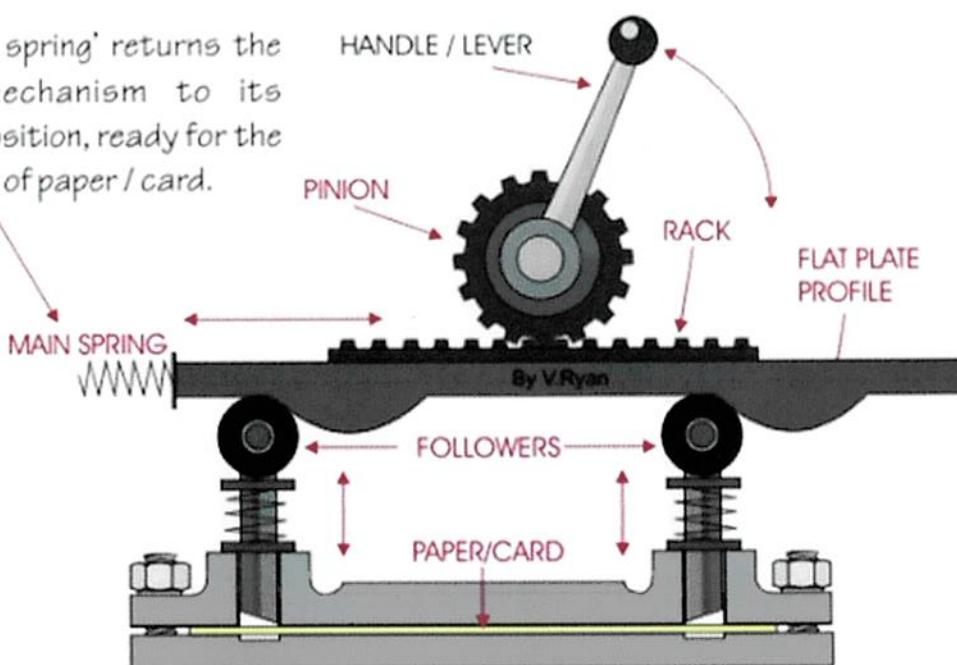
# THE FLAT PLATE CAM / LINEAR CAM

This is a more sophisticated example of a flat plate / linear cam. The follower is unusual because it has a roller / wheel to help the smooth movement of the flat profile cam and follower. It also has a return spring that pushes the follower against the profile, ensuring that it always runs against it and follows the shape precisely.



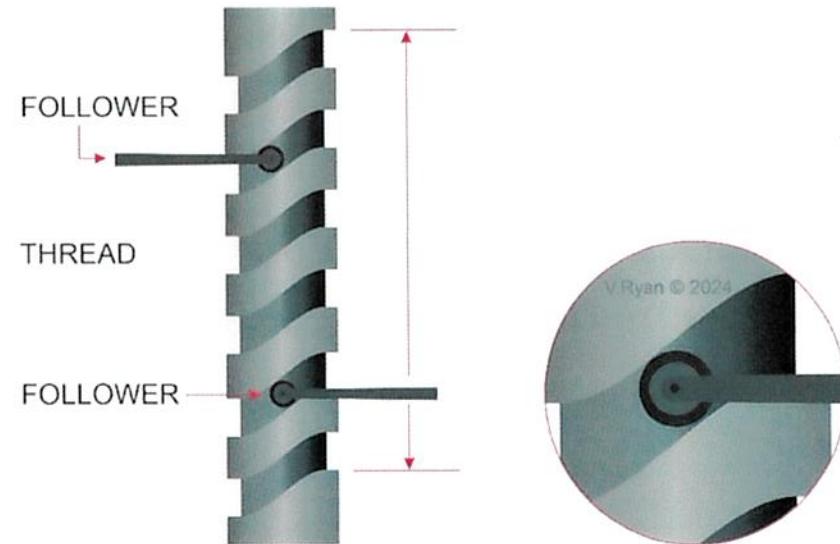
The machine opposite, is a mechanical paper punch. As the lever is pushed down a gear system (called a rack and pinion) moves the flat plate profile to the left. In turn this pushes down the followers which punch two holes in a piece of paper / card.

The 'main spring' returns the entire mechanism to its original position, ready for the next piece of paper / card.



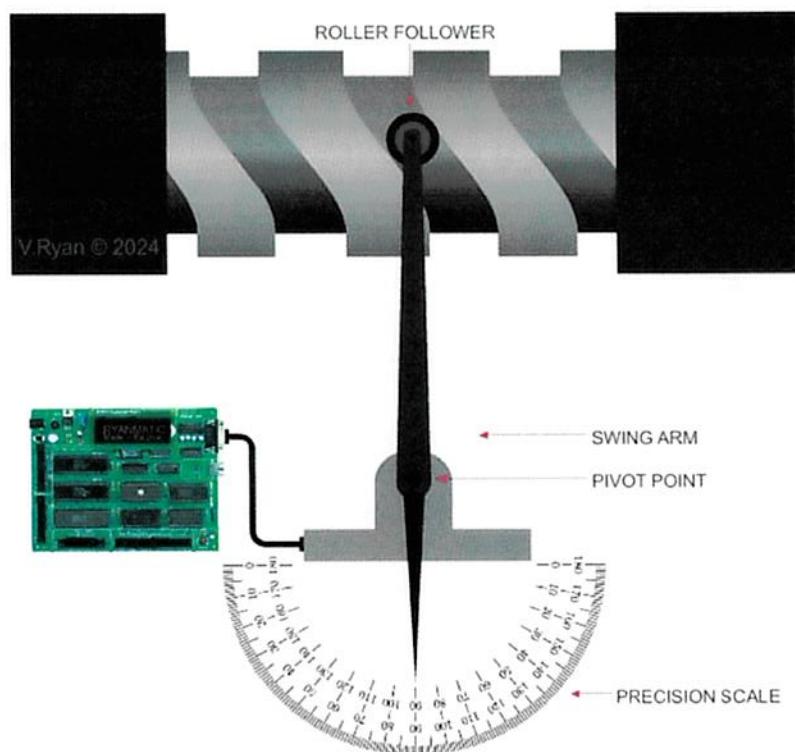
# CYLINDRICAL CAM / BARREL CAM

Cylindrical cams are often used when precise, smooth movement is required. They are sometimes used in equipment when fine adjustment is necessary. A roller follower is ideal for this application and this type of follower is unlikely to jam. It is also possible to have multiple followers working with the same thread.



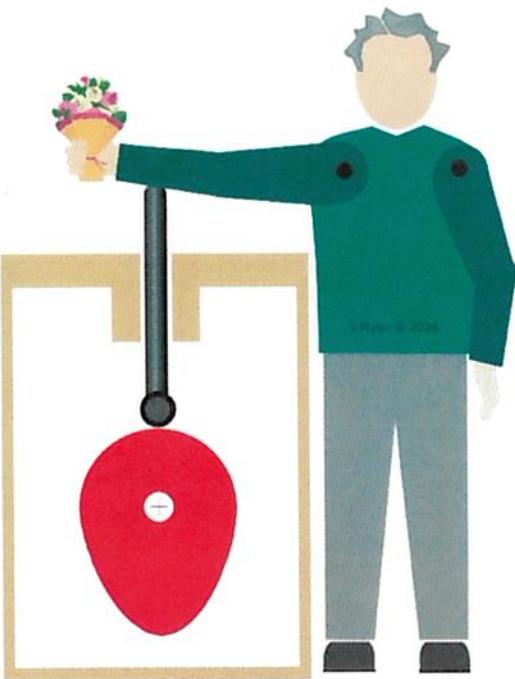
A specialised measuring / sensing device is seen opposite. It accurately measures movement to the right and left. It is part of a control system, that ensures a robotic vehicle in a factory, stays within a path drawn on a factory floor. If the device detects too much movement left or right, the control system automatically corrects the direction of the robot.

One of the most important components is the cylindrical cam. This is composed of a large screw thread and a roller follower (called the swing arm). The roller follower ensures that movement of the swing arm is smooth and 'jam' free.



# CAM QUESTIONS

The diagram below represents a simple CAM driven, mechanical toy.



4. Search the internet for images of products that include a cam mechanism. Paste the images below.

1. On the diagram, label the follower, profile and pivot. **3 marks**

2. Describe what happens as rotation of cam profile takes place. **4 marks**

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3. What is the technical name of the shape of cam? **1 mark**

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# CAM QUESTIONS

1. Complete the following sentence:

A CAM changes \_\_\_\_\_ motion (a rotating motion) to \_\_\_\_\_ motion (one that moves in a straight line). They are found in many machines and toys. **2 marks**

2. Sketch and explain a simple CAM. Label the profile and follower. **6 marks**

SKETCH

EXPLANATION:

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3. Describe and sketch a device that has a CAM as part of its mechanism. **6 marks**

SKETCH

NOTES:

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4. Explain the following terms (**6 marks**):

ONE CYCLE:

DWELL:

THE RISE:

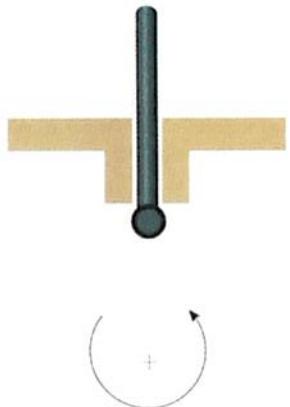
5. Sketch the following types of follower (**8 marks**):

FLAT FOLLOWER

POINT/KNIFE FOLLOWER

ROLLER FOLLOWER    OFFSET FOLLOWER

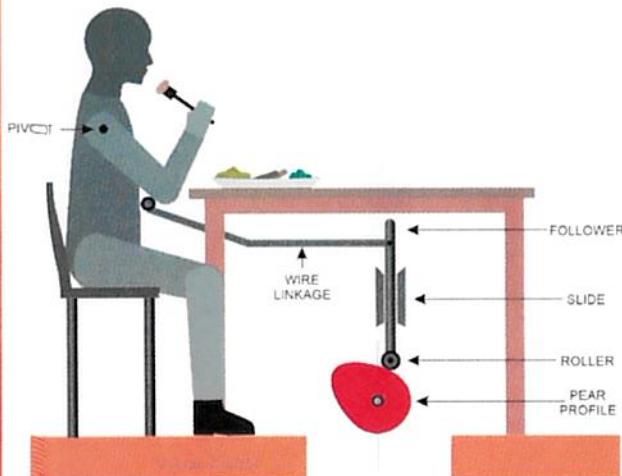
## EXAMINATION QUESTIONS - PEAR SHAPED CAMS



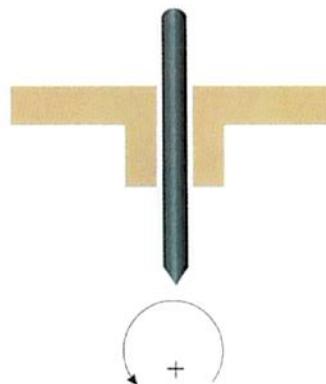
1. Complete the diagram shown opposite by adding a cam that has a pear shaped profile. **2 marks**

2. Describe the motion of the follower when a pear shaped cam is used. **2 marks**
- 
- 

3. Describe how the pear shaped cam below, creates movement of the model. **3 marks**
- 
- 
- 



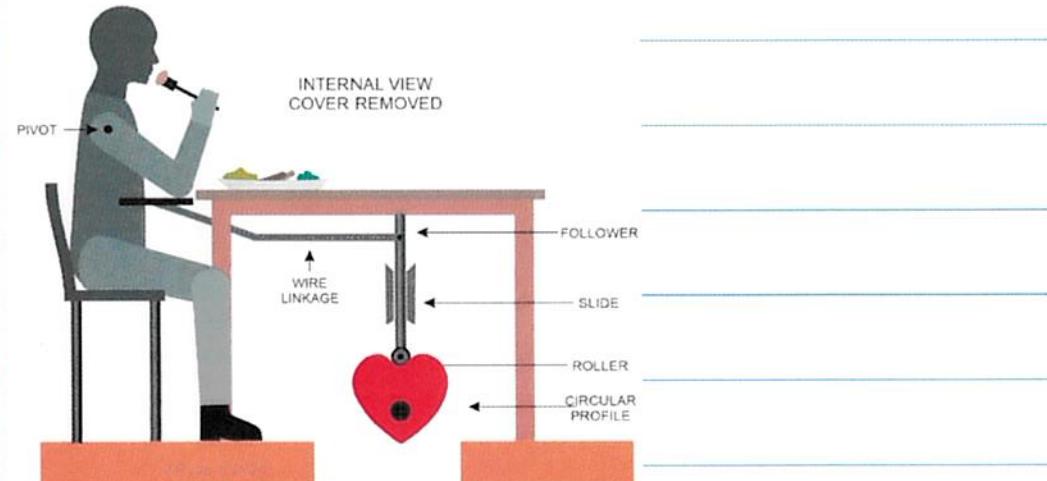
## EXAMINATION QUESTIONS - HEART SHAPED CAMS



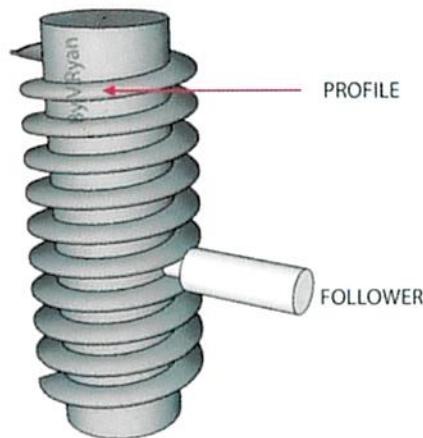
1. Complete the diagram shown opposite by adding a cam that has a heart shaped profile. **2 marks**

2. Describe the motion of the follower, when a heart shaped cam is used. **2 marks**
- 
- 

3. Describe how the heart shaped cam below, creates movement of the model. **3 marks**
- 
- 
- 



## EXAMINATION QUESTIONS - CYLINDER CAM



1. A cylindrical cam and its follower are shown opposite. Explain how this type of cam system works. **2 marks**

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2. Why is it important that a roller follower is used with this type of cam. **2 marks**

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3. Paste an image or sketch a device that incorporates a cylindrical cam. Explain the function of the device. **6 marks**

## SWASH PLATE CAMS

1. Sketch a Swash Cam and follower. Explain how they work. **6 marks**

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2. A swash plate cam usually has a 'roller' follower. What would happen if a flat follower was used? **3 marks**

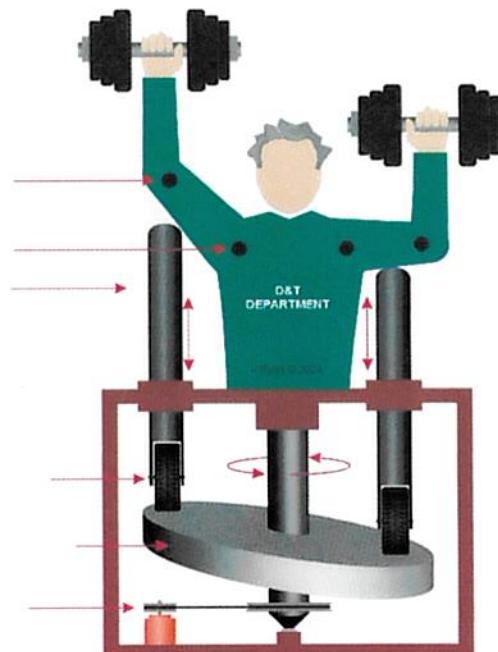
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- 3a. Label the parts of the mechanical toy, identified by arrows. **6 marks**

- 3b. Why is a pulley system used, as part of the 'drive'. **2 marks**

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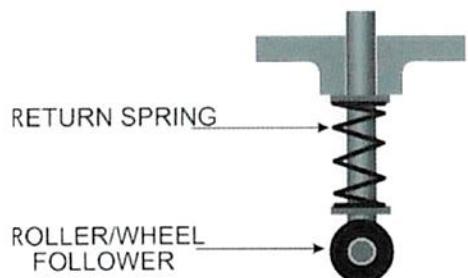
# EXAMINATION QUESTIONS - FLAT PLATE CAMS

1. In the space below draw a simple example of a flat plate cam and its follower. Label important parts and add notes that explain how it works. **6 marks**

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2. Roller followers are normally used with flat plate cams. Why is this the case? **2 marks**

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3. The roller follower seen above has a return spring. Why is this often required? **2 marks**

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4. In the space below draw a practical application of a plate cam and follower(s). Add explanatory notes. **6 marks**

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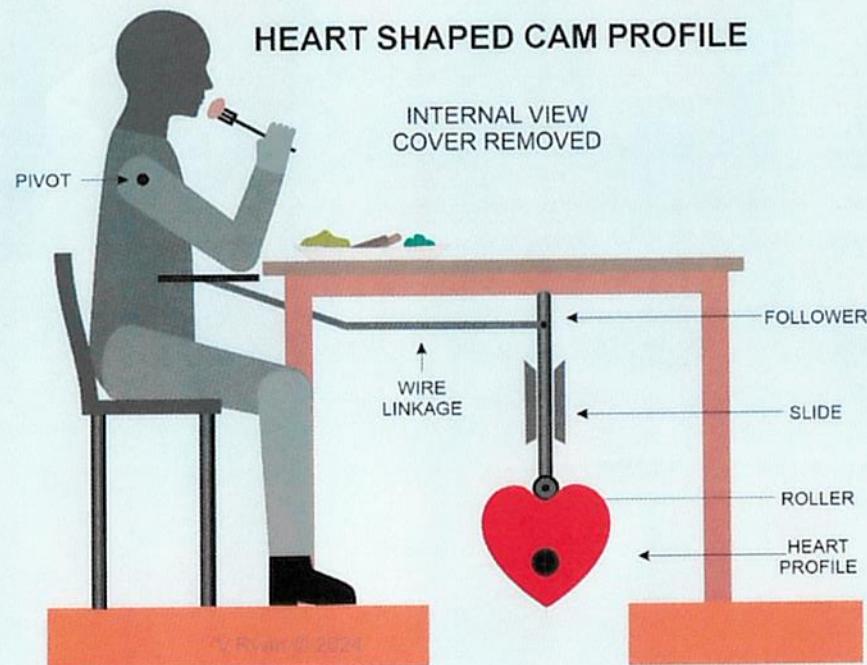
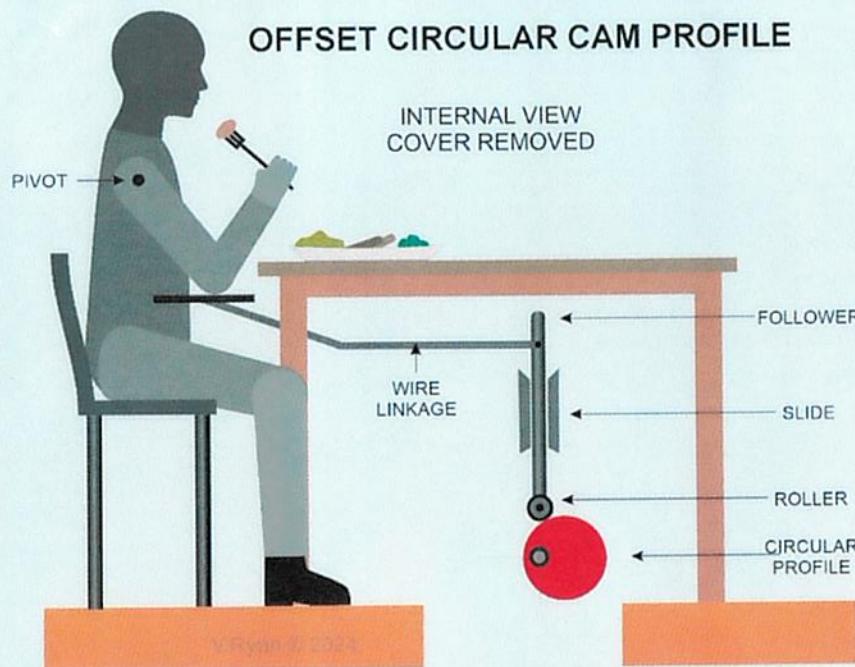
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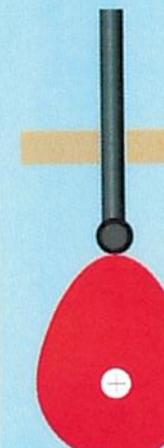
# COMMON CAM PROFILES

World Association of Technology Teachers <https://www.facebook.com/groups/254963448192823/> V.Ryan © 2025



## PEAR

Pear shaped cams are used on the shafts of cars. The follower remains motionless for about half of the cycle of the cam and during the second half it rises and falls



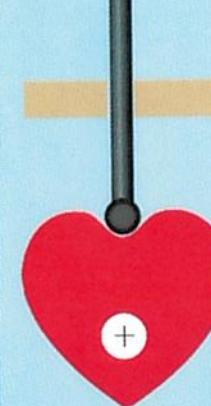
## CIRCULAR

Circular cams or eccentric cams produce a smooth motion. These cams are used in steam engines.



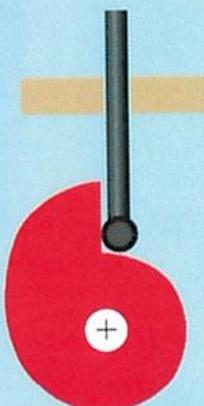
## HEART

Heart shaped cams allow the follower to rise and fall with 'uniform' velocity.



## DROP

What type of movement do you think this cam profile will give ?



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A heart-shaped cam profile looks like a heart. It results in a steady rise and fall motion and uniform velocity. However, when applied to this mechanical toy, it does not give a suitable movement of the arm.