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# Chainless Bicycle

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***Abstract: The principle point of the venture was "to create a chainless bicycle" which works on the principle of crank lever mechanism. A crank lever bicycle is a bicycle that uses a crank drive instead of a chain which contains two set of effort arms which work as a pedal at both end of the crank to make a unique type of transmission system for a bicycle for getting an efficient system.***

***Chain and sprocket are usually used in bicycles, this method is used to drive the back wheel via crank –lever, bikes have a variable crank where a conventional bike would have its chain ratchet. The use of crank allows the axis of the ratchet to receive torque from the effort arm to be turned through 82 degrees.***

***The drive shaft then has another crank on another side of the rear wheel hub which transmits the torque to the ratchet making the wheel rotate.***

***Keywords: Chainless bicycle, ratchet, crank lever mechanism, fabrication and effort arm***

## I. INTRODUCTION

A crank-lever bicycle is a bicycle that uses a drive crank instead of a chain to transmit power from the effort arm to the rear wheel. In this chainless bicycle the origin of pedal has been changed, usually it is near chain wheel, but in this chain less bicycle the pedal is placed at the back frame, it is fabricated in such a manner that it is above the rear wheel center. The pedal which is an effort arm is attached with a bush which is then bolted with the frame with a bearing so it can transmit the motion smoothly, and locked by a circlip so that it is prevented from moving away from the centre.

Then the effort arm (pedal) is connected to the crank by the connecting rod, where the connecting rod is designed in such a manner that both the ends of connecting rod have a roller bearing to let the motion transmit to crank swiftly, here the connecting rod is bolted in the hook of the effort arm which measures 173 mm in length, and on the other side, it is bolted with the crank.

The effort arm (pedal) is bent from the end to let the foot to rest easily on it; a spring is also attached with the upper portion of the frame so that pull can be avoided for an effortless transmission. Vertical pedalling, that is 180 degree motion allows the torque to be converted into rotary motion

The crank is the most important part of this bicycle; it is designed in such a manner that it will provide a sufficient motion to the wheel over the ratchet.

A shaft is passed though the rear wheel hub from where the crank, the ratchet and the two pedestal beadings are mounted in the centreline of the axis of the wheel. The ends of the shaft are threaded so that the crank can be locked by a lock nut and a nut at the back so that it will only transmit the motion to the ratchet and not move.

The ratchet is held up by a circular disk which is slightly bigger in size in comparison to the ratchet. The space width between the two teeth of the ratchet are bolted three times to the spokes from single side, where both sides of spokes are covered by the small metal strips so that the vertical energy is converted into circular motion and transmits to the wheel.

Here the pedestal bearings are bolted to the chaise and from there the shaft holds the wheel and other components. The pedestal bearing provides the motion easily as it has roller bearing. The hub of the wheel is greased with the roller balls of small size so that the shaft can rotate in the centre line of the axis of the wheel

## II. USE OF CRANK LEVER

The crank lever mechanism helps convert the vertical motion into the rotational motion. The torque produced by the effort arm and the transmission shall be transferred to the rear wheels to drive the vehicle forward. The effort arm must provide a smooth, uninterrupted flow of power to the crank.

## III.COMPONENTS

### *A. Hub*

Core part of the wheel has radial spokes; all bearings are inserted in the hub to enable the axle to rotate. Bearing: For smooth motion of the effort arm, bearing mechanism is used where the effort arm is mounted. To have very less frictional loss, the two ends of connecting rod are pivoted into the same dimension roller bearing.

Fig. 1 The hub

### *B. Pedestal Bearing*

The Pedestal bearing is used to provide support to the rotating shaft with the help of a compatible bearing & the crank. It is bolted with the frame so that it can be removed easily in case if it needs to be repaired.

### *C. Shaft*

A shaft is a long piece of metal, circular in cross section, in an engine or machine that turns and transmits power or movement to another part of the machine. They are used for transmitting rotary motion and torque from one point to another.

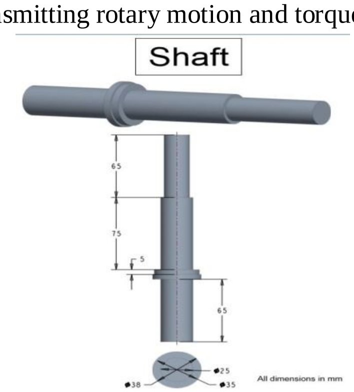


Fig. 2 Shaft

### *D. Effort arm (pedal)*

An effort arm is a simple machine consisting of a rigid rod pivoted at a fixed hinge; it is a rigid body capable of rotating about a point on itself, on the basis of  the location of fulcrum, load and effort.

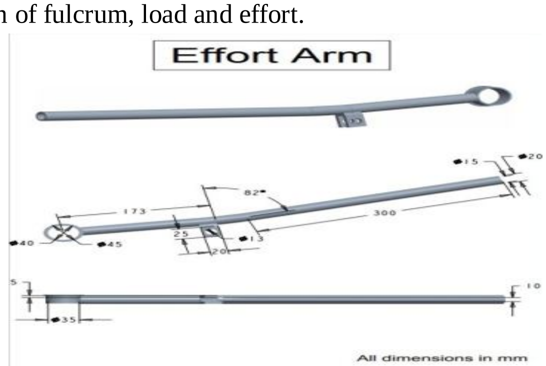


Fig. 3 Effort arm

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*E. Crank*

The crank converts vertical torque into the circular motion, it is mounted on the shaft.

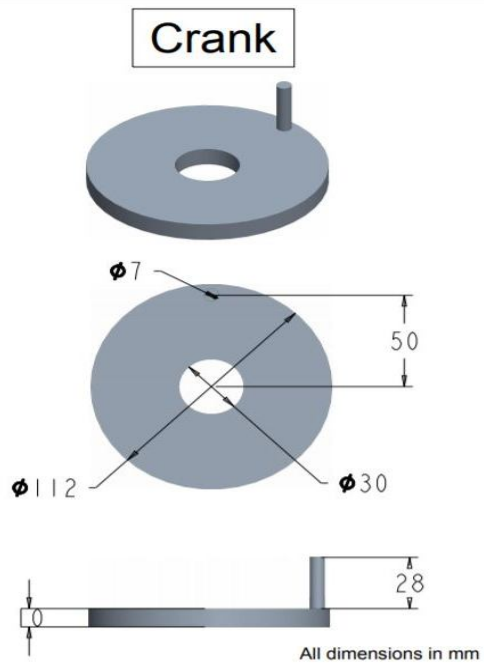


Fig. 4 Crank

*F. Connecting Rod*

A connecting rod, also called a con rod, connects the lever/pedal to the crankshaft. The connecting rod converts the reciprocating motion of the effort arm into the rotation of the crankshaft.

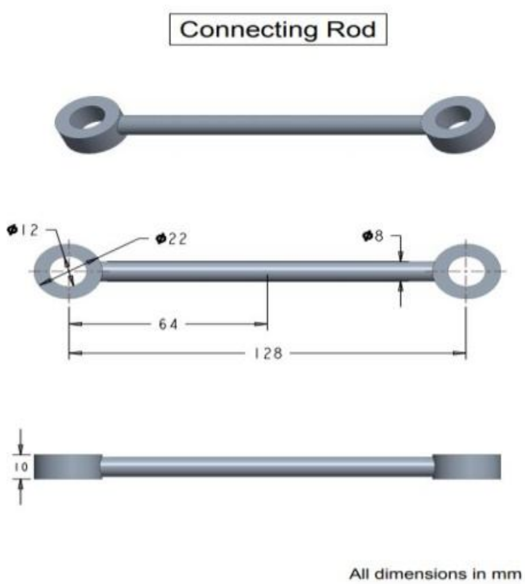


Fig. 5 Connecting rod

*G. Fender*

Piece of curved metal which covers a part of the wheel to protect the cyclist from splashing dirt.

*H. Break*

Mechanism triggered by brake cable which compresses a return spring calliper. It forces a pair of brake pads to the sidewalls of the wheel rim to stop the bicycle.

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## IV. MATERIAL AND FABRACATION PROCESSED

### A. Material used

1) Bicycle frame of atlas cycle.
2) MS pipe of 18mm diameter for additional frame.
3) MS pipe of 20mm diameter for effort arm.
4) Cast iron disk for frame.
5) MS rod of 8mm diameter for Connection rod.
6) MS crank of 100mm diameter.
7) MS rod of 40mm diameter for shaft.
8) Key bar of 6x6mm.
9) MS plate of 10x15mm.
10) Fasteners.
11) Pedestal bearing.
12) Roller bearing.
13) Circlip.
14) Basic bicycle parts.

### B. Fabrication Process

1) Cutting of frame from the rare end.
2) Bending and welding of ms pipe on the frame.
3) Welding of cast iron disk in between the ms pipe and frame.
4) Welding of ms plate at the rare end.
5) Produced the shaft as per dimension on lathe machine.
6) Mounting of hub on the rare wheel.
7) Produced the crank as per dimension.
8) Welding of distal pin on the crank.
9) Bending the ms pipe for effort arm (pedal).
10) Brazing of small ring on the rod for connection rod.
11) Welding of ratchet on disk and mounting on shaft.
12) Mounting of pedestal bearing on rare end
13) Assembly of mechanism on the frame of bicycle.

Fig. 6 Back side of chainless bicycle

## V. CALCULATION

### A. Dimensions

1) Pedal length = 0.50m
2) Connecting Rod = 0.128m
3) Crank radius = 0.55m
4) Shaft radius = 0.01m
5) Pedestal bearing = 0.025 m
6) Stroke length =0.3 m

*B. Force analysis*

P*475=W*173
P*475=3300*175
P=1202 N
Mechanical Advantage
=W/P
=3300/1202
=2.745
Reaction force
Fr=√ $(W^2 + P^2 – 2WP\cos\Theta)$
Fr=4488.5
Moment=W (L-D/2)
=3300(173-20)
=505Nmm
Moment=P (L-D/2)
=1202(300-20)
=962Nmm

*C. Grashof's law*

The Grashof's law states that for a four-bar linkage system, the sum of the shortest and longest link of a planar quadrilateral linkage is less than or equal to the sum of the remaining two links, then the shortest link can rotate fully with respect to a neighbouring link.

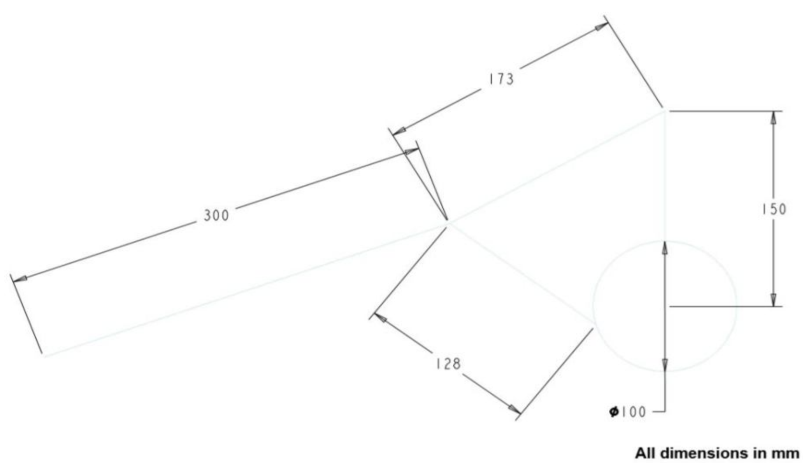


Fig. 7 Grashof's law

(50+173)< (128+150)
This proves that the mechanism will run properly according to grashof's law

## VI. ADVANTAGES

*A.* The main objective of this project is to modify the existing drive mechanism of a bicycle to reduce the effort which is required for driving a conventional bicycle.
*B.* The movement of the lower limb of the chain less bicycle is similar to the marching movement, making it much simpler to make the bicycle move forward.
*C.* Gravity and Near Vertical Pedalling combined with the rider's weight, produce an increased and continuous force throughout the entire pedal stroke.
*D.* A cyclist may be able to develop strong quadriceps and hamstrings with the use of such a bicycle.
*E.* The strain in the knee will reduce with the use of chain less bicycle and will be helpful for the people having reduced range at the knee joint and hip joint.

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## VII. PRACTICAL ANALYSIS

TABLE I

| Sr. No. | With spring (rpm) | Without spring (rpm) | Normal cycle (rpm) |
|---|---|---|---|
| 1 | 78 | 77 | 76 |
| 2 | 76 | 78 | 77 |
| 3 | 74 | 79 | 79 |
| 4 | 75 | 76 | 77 |
| 5 | 76 | 77 | 79 |
| Average | 75 | 77 | 77 |

Fig. 8 Chainless bicycle

## VIII. CONCLUSION

From this design, we conclude that the efficiency of chainless bicycle is more than that of chain driven bicycle. The motion of pedals in a chainless bicycle is $180^o$ whereas in chain driven bicycle it is $360^o$. Gravity and Near Vertical Pedalling combined with the rider's weight, produce an increased and continuous force throughout the entire pedal stroke.

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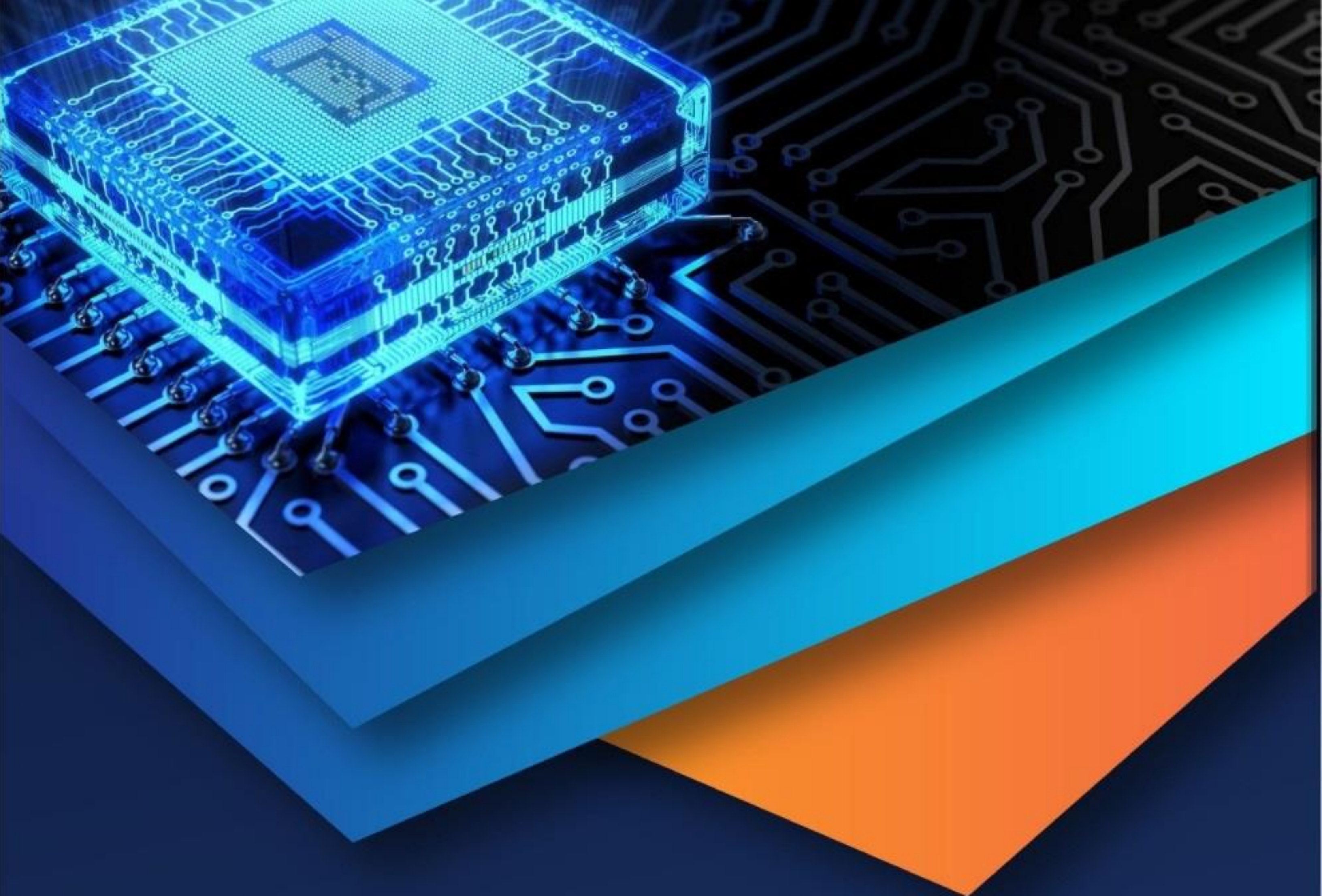

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