# Design and Analysis of Motorized Bicycle to Reduce the Human Efforts

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*Abstract*— In the modern era of automobile there are need to be simple construction vehicle which is convenient for workers, suppliers, and people for transportation function and for carrying goods. So, we are trying to constructs motorized bicycle which will help people for transportation with optimum cost and less effort. By using the engine from Luna TFR we are going to assemble it on the rear wheel of bicycle, which will operate by fuel (petrol). Generating power ultimately rotate the pulley mounted on the crankshaft at either side of the engine and pulley is connected with rear wheel of bicycle with the help of belt and idler pulley on it and it will rotate the rear wheel of bicycle. If we can imply this phenomenon in load carrying tricycles it will less the human effort. By use of this we can minimize traffic issues because it is compact in size and low speed bicycle.

***Key words:*** Motorized Bicycle, Luna TFR, Belt and Pulley, Human Effort, Traffic

## I. INTRODUCTION

The petrol powered bicycles were capable of being driven without need for the rider to pedal other than at start up all the petrol power bicycles were able to obtain higher speeds than pedaling; all the petrol powered bicycles took longer to stop than the pedaling. The unrestricted engines produced far in excess of the maximum power allowed; and although the restricted was under the maximum power limit, the restricting device could be easily removed or bypassed in less than five minutes. Today the interest in cycling is increasing worldwide and in many countries authorities are faced with the question how cycling can be promoted efficiently. In the Netherlands and Denmark, this question came up already in the 1970s when the downsides of the rapidly increasing motorization became evident. At the time, in both countries large scale interventions in bicycle

Infrastructure were introduced and evaluated extensively in order to create knowledge on efficient promoting of cycling in urban areas [1]. In countries all over the world a growing interest in the bicycle can be observed.

There is an increasing acknowledgement that a shift from motorized modes to the bicycle relieves traffic problems regarding congestion and environment, and that cycling contributes to the fitness and health. The importance of bicycle promotion is recognized in a number of European countries (ECMT, 2004) and the United States (U.S. Department of Transportation, 2010), and in many other regions initiatives are taken to raise the level of bicycle use. The higher interest in cycling generates demand for knowledge on effective bicycle promoting policy [2]. The Netherlands and Denmark, the two countries with the highest level of bicycle use in the western world credited with a guiding role. Phil Jones Associates (2014) report in their search for best practices for cycling infrastructure that "almost every authority we visited outside the Netherlands or Denmark explicitly stated that they had looked to cities in these countries for guidance on how they might grow cycling". In these countries, the acknowledgement that the bicycle is an important mode that should be promoted came up early, in the 1970's, and gave cause for a number of sometimes extensive research projects. The projects gave a wealth of knowledge on design, travel behavior, safety, and other aspects that are relevant for a good bicycle policy, and they are at the root of the current leading role of the countries regarding cycling [3].

### *A. Electric Bicycle*

Electric bicycles, also called e-bikes, can be a viable solution to the world's energy crisis because they can substitute motor vehicles for midrange transportation needs with zero emission. Indeed, a vehicle as the e-bike constitutes an alternative vehicle for both personal mobility and goods delivery, especially for small and medium distances. The e-bike, in all its forms, two or three wheels (tricycle), is able to move with an average speed equal to the typical one of the town traffic and, at the same time, it requires energy for its mobility that is very close to the necessary energy just for the displacement of the transported people [4]. There are two kinds of electric bicycle. A first kind includes an electric motor into bicycle frame or wheels, and it is driven by motor using a handlebar throttle A second kind is a power-assisted bicycle, also called pedelec which is a human–electric hybrid bicycle that supports the rider with electric power only when the rider is pedaling. Typical e-bikes are equipped with an electric motor, a battery, a control unit and sensors to detect ride torque and bicycle speed. The motor torque, determined by the control unit, plays a crucial role in ensuring the comfort and the safety of pedaled riding [5].

## II. PROBLEM DEFINITION

While riding a bicycle at uphill, there comes the need of more man power to ride a top. The person while riding bicycle uphill has to use more force and hence gets exhausted i.e. by pedaling more. The force required is high and it has to be reduced by some form of energy. Hence there is a need to develop bicycle powered by mechanical energy. A engine bicycle is a bicycle with an attached engine parts used either to power the vehicle unassisted, or to assist with pedaling. Since it always retains both pedals and a discrete connected drive for rider-powered propulsion, the engine bicycle is in technical terms a true bicycle, or a power assisted one. Motorbikes have utilized all variety of engines, from internal combustion (IC) two-stroke and four-stroke gasoline engines to electric, Petrol, or even steam propulsion. Most engine bicycles are based or derived from standard general-purpose bicycle frame designs and technologies, although exceptions abound. In addition, modifications to a standard bicycle frame to support engine may be extensive.

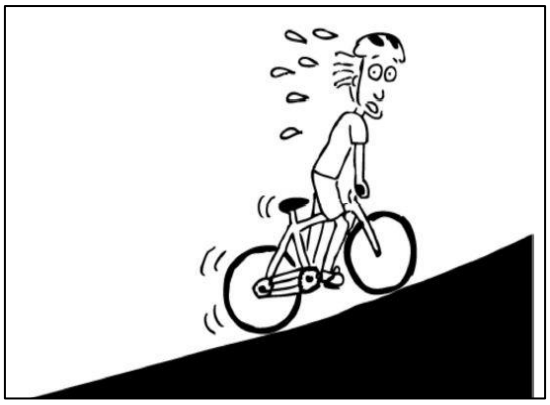


Fig. 1: Bicycle climbing the road

## III. PART DETAILS

The essential parts of the engine which are used in the motorized bicycle are as follow.

- Cylinder block
- Cylinder head
- Piston & Piston ring
- Connecting rod
- Crank shaft
- Spark plug
- Carburetor
- Magneto

And other accessories like fuel tank, friction wheel, brakes, wires and magneto.

Motorized bicycle called as a power assisted pedal cycle is deemed to be a standard bicycle. It can be used without the need to comply with vehicle standards or for it to be registered, or for the rider to be licensed; and the rider is subjected to the same road rules as one riding a conventional bicycles. The recent demand for more efficient, environment-friendly vehicles has seen a growth in the market for power assisted pedal cycles. This demand has seen a number of engine bicycles entering the market that are not genuine power assisted pedal cycles, but the form of moped or even small motor cycles. Typically, the primary source of power on this motorized bicycle is from the engine not the rider. There have been particular load safety concerns about bicycles fitted with petrol engines due to the amount of power these engines can produce.

### *A. Cylinder Block*

Cylinder block, cylinder head and crankcase – theses three parts from the foundation and main stationary body of the automobile engine. They serve as support and enclosure for moving parts. In modern engines, the cylinder block and crankcase from a single casting, which givers rigid structure. The cylinder block may also have a separate crankcase for the crankshaft, which is mainly confined to large engines, marine and stationary engines.

A cylinder block consists of three parts:

1) The cylinder in which the pistons slide up and down.
2) The ports or openings for the valves.
3) The passages for the flow of cooling water.

Fig. 2: Cylinder Block

### *B. Cylinder head*

In an internal combustion engine, the cylinder head (often informally abbreviated to just head) sits above the cylinders on top of the cylinder block. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by a head gasket. In most engines, the head also provides space for the passages that feed air and fuel to the cylinder, and that allow the exhaust to escape. The head can also be a place to mount the valves, spark plugs, and fuel injectors. The cylinder head is usually made of grey cast iron or aluminum has the advantage of lightness in weight and high heat conductivity. It is cast separately from the cylinder block so that it may be removed for cleaning carbon and grinding valves. To retain compression in the cylinder, a flat piece of gasket is placed between the cylinder head and the cylinder block. In certain cases, such as a racing car engine, a separate head is not used. But a single piece of cylinder block and head is difficult and costlier to make and the internal parts of the engine are not as accessible.

Fig. 3: Cylinder Head

### *C. Cylinder Head Gaskets*

A gasket is placed between the cylinder head and cylinder block to retain compression in the cylinder, to prevent leakage and to ensure metallic tight fit joint. The gasket should be able to withstand not only high pressure but also extreme temperature.

Following important gaskets are used in automobile engines:

1) Copper – asbestos gasket.
2) Steel – asbestos gasket.
3) Steel – asbestos – copper gasket.
4) Single steel ridged or corrugated gasket.
5) Stainless steel gasket.

Fig. 4: Cylinder Head Gasket

*D. Piston*

Piston is consider to be one of the most important parts in a reciprocating engine in which it helps to convert the chemical energy obtain by the combustion of the fuel into useful mechanical power. The purpose of the piston is provide a means of conveying the expansion of the gases to the crankshaft, via the connecting rod, without loss of gas from above or oil from below. Piston is essentially a cylindrical plug that moves up and down in the cylinder. It is equipped with piston ring to provide a good seal between the cylinder wall and piston. Although the piston appears to be simple part, it is actually quite complex from the design stand point.

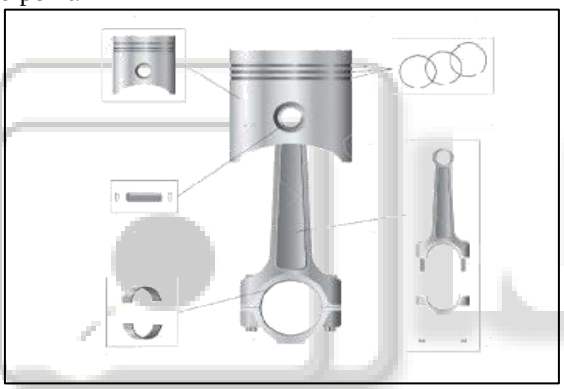


Fig. 5: Piston

*E. Combustion chamber*

Combustion chamber is the space enclose between the piston head and cylinder head when the piston is at the top dead centre position. It extends up to the upper compression ring of the piston. Exhaust and inlet valve open and close in the combustion chamber and the spark plug projects in it. The design of the combustion chamber is of great importance for the engine performance because the air-fuel mixing and combustion take place in it. Depending upon the location of the spark plug, valve and the type of cylinder head, the combustion chambers are of the following shapes:

1) Spherical shape
2) I-shape
3) T-shape
4) F-shape
5) L-shape

In the spherical shape combustion chamber, the inlet and exhaust valve are fitted in the cylinder head. Spark plug may be at a side or top of the cylinder head.

*F. Connecting rod*

The connecting rod is the connection between the piston and crankshaft. It joins the piston pin with the crankpin. Small end of the connecting rod is connected to the piston pin and big end to the crank pin. The function of the connecting rod is convert linear motion of the piston into rotary motion of the crankshaft. The connecting rod usually has I-beam cross-section; and is made of forged steel. Aluminum alloy is also used for connecting rod. They are carefully matched in sets of uniform weight in order to maintain engine balance. The lighter the connecting rod and the piston, the greater the resulting power and the lesser the vibration because the reciprocating weight is less. The connecting rod carries the power thrust from piston to the crank pin and hence it must be very strong, rigid, and also as light as possible.

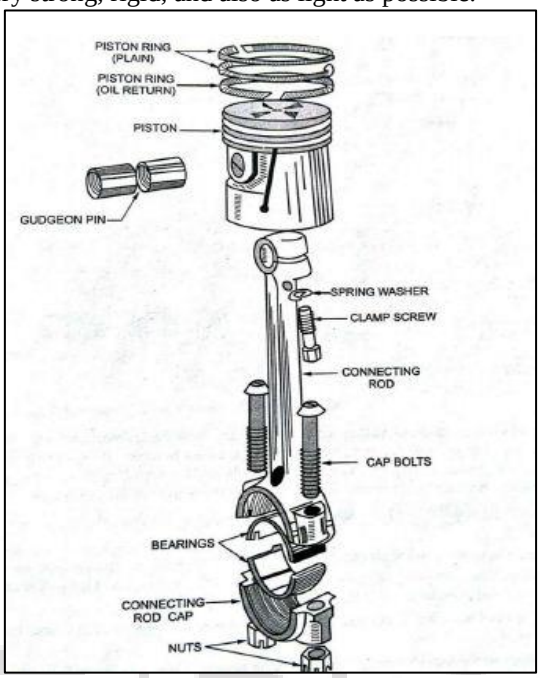



Fig. 6: Connecting Rod

*G. Crankshaft*

Crankshaft is the first part in the power transmission system on to which the reciprocating motion of the piston is converted into the rotating motion with the help of the connecting rod. A crankshaft consist of crankpin, webs (crank arms and cheeks) balancing weights and main journals. Big end of the connecting rod is connected to the crankpin of the crankshaft. Centre to centre distance between the crankpin and crankshaft is half of the piston displacement during the stroke. Thus, one complete revolution of the crankshaft makes two strokes of the piston. The part of the crankshaft inside the main bearing is called the main journals. The crankshaft is supported by the main bearings on the main journals. Balancing weights are provided on the opposite side of the crank arms for the balancing.

*H. Spark plug*

A spark plug is a device for delivering electric current from an ignition system to the combustion chamber of a spark-ignition engine to ignite the compressed fuel/air mixture by an electric spark, while containing combustion pressure within the engine. A spark plug has a metal threaded shell, electrically isolated from a central electrode by a porcelain insulator. The central electrode, which may contain a resistor, is connected by a heavily insulated wire to the output terminal of an ignition coil or magneto. The spark plugs metal shell is screwed into the engine's cylinder head

and thus electrically grounded. The central electrode protrudes through the porcelain insulator into the combustion chamber, forming one or more spark gaps between the inner end of the central electrode and usually one or more protuberances or structures attached to the inner end of the threaded shell and designated the side, earth, or ground electrode(s).

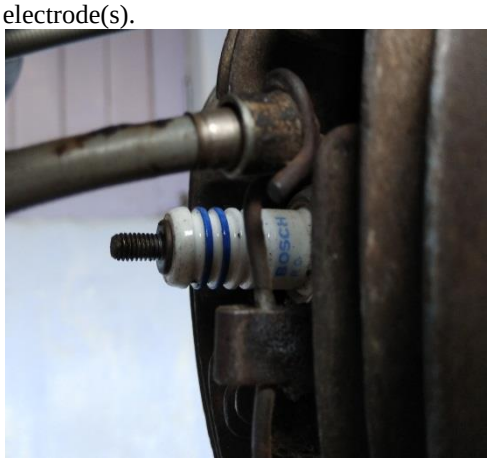


Fig. 7: Spark Plug

## IV. ASSEMBLY

After completing the parts, the full Assembly of the engine has been done by assembling the various parts like cylinder, cylinder head, piston etc. The whole Assembly of the engine has been mounted on the rear wheel of the bicycle.

Cylinder and head assembly:- The cylinder head sits above the cylinders on top of the cylinder block. It closes in the top of the cylinder, forming the combustion chamber. This joint is sealed by head gasket. In most engines the head also provides space for the passages that feed air and fuel to the cylinder, and that allow the exhaust to escape. The head can also be a place to mount the valves, spark plugs, and fuel injector.

### *A. Installation*

1) Install the cylinder head and gaskets on cylinder block.
2) Tighten the cylinder head bolts.
3) Install the cam shaft.
4) Install the valve rocker assembly.
5) Install the spark plug.

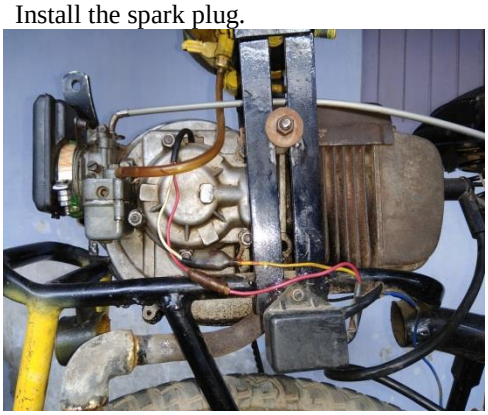


Fig. 8: Cylinder Assembly

Rear wheel construction: - Due to limitation of load carrying capacity if there should not be change in design of rear wheel then it should not withstand the load of the engine and the operator of the bicycle. There should be damage of spoke or change in shape of rim which leads to unnecessary movement of the belt and sprocket chain; it leads to the accident condition. So there should be replacement of spoke which is bonded at inside at rim periphery and other side on the outer periphery of LUNA TFR drum.

The little change in rear wheel should help the load carrying capacity of bicycle. The gear box of LUNA TFR is fitted on the rear wheel inside the drum of LUNA TFR. The main purpose of the gear box is to give the anticlockwise motion if the wheel is rotating in the clockwise direction and vice versa. There should also be sprocket or the connection of rear wheel with pedals by means of chain and the sprocket is fitted on the shaft.

The whole wheel as mentioned above in the construction area is fitted on the chassis of the bicycle.

There should be shaft which holds the rear wheel in the chassis of the bicycle. One pulley is attached on the shaft of the rear wheel, by means of belt there should be connection between rear wheel and magneto (on the engine crank).

There should also be sprocket which is used for the driving purpose of rear wheel with pedal sprocket by means of chain.

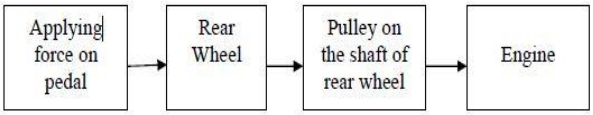
The connection of belt between pulley and magneto is at left hand side of the operator and chain sprocket mechanism is at the right hand side of the operator.

There should be little change in chassis at the rear wheel of the bicycle as shown in below figures; there should be attachment of new supports to the rear wheel in place of old supports by cutting them. For the assembly of engine, the frame is weld on the carrier of bicycle and extra supports is provided at the end of it to carry the load of engine without shocks.

Fig. 9: Rear Wheel Assembly

## V. METHODOLOGY AND SPECIFICATION

The engine should be started by applying force on the pedals of bicycle. Rear wheel is rotated by means sprocket chain; there should attachment of pulley on the shaft of rear wheel. And there should be connection of pulley with magneto (on crankshaft of engine) by means of rubber belt. As the rear wheel rotates, it should generate spark in the cylinder by means of rotation of magneto (rotation of magneto produce the A.C current and it leads to the generation of spark).



As the pulley on the rear wheel rotates the magneto is also rotates by means of rubber belt and which produces spark in the combustion chamber through spark plug for the purpose of combustion. From the generated power in the form of combustion it drives the piston and rotates crank shaft continuously which ultimately drives the bicycle as per requirement.

As in the ordinary bicycle there should be connection between rear wheel and the pedal by means of sprocket chain. On the rear wheel there should be drum of LUNA TFR and the gearbox is fitted inside it, which gives correct forward motion to the rear wheel. The pulley is attached on the shaft of rear wheel at the left side of the bicycle. As the rear wheel rotates pulley is also rotated. There should be magneto on the crankshaft of the engine and there should be connection between pulley on the shaft of the rear wheel and the magneto by means of belt.

As the operator applies force on the pedals with combine action of pressing the clutch the spark is generated in the combustion chamber. Generation of power is done when forces applied on the pedal the rotary motion of the sprocket chain transfer to the rear wheel and the rotation of it should also rotates the pulley which ultimately rotate the magneto and the spark is produced in the combustion chamber. The produced power in the engine gives the continuous motion of crankshaft which leads to the running action of bicycle.

*A. Specification*

| | | |
|---|---|---|
| Chassis | Front wheel diameter | 56cm |
| | Rear wheel diameter | 56cm |
| | Weight | 62kg |
| | Width | 52cm |
| | Diameter of pulley | 8cm |
| | Clearance | Front - 4cm<br>Rear - 3cm |
| | Engine - spark coil gap | 6cm |
| | Clutch housing - pulley Gap | 46cm |
| | Brakes | Shoe Brake |
| | Wheel base | 108 cm |
| | Ground clearance | 107 cm |
| Engine | Type | Two stroke |
| | Cylinder | Single |
| | Bore | 49.8 cm |
| | Stroke | 43 mm |
| | Compression ratio | 9:1 |
| | Power transmission | Belt |
| Electrical system | Ignition type | Magneto |
| | Spark plug | RC4HC |
| | Generator | Magneto |
| Fuel capacity | Fuel tank | 3 ltr. |

Table 1: General Specification

*B. Actual Working Model*

Fig. 11: Working Model of Motorized Bicycle

## VI. Conclusion

The project is carried out by an impressive task (reduce the effort of human) in the automobile industries. At the starting stage of the definition of the aim of project is carried out which clears the idea about model. That is done by collecting the data from various sources. After that the selection of the parts which is suitable for the construction of the motorized bicycle is done. As per this method engine is mounted by means of frame on the rear wheel and the pulley is connected on the shaft of rear wheel by means of rubber belt, which ultimately start the engine. The main aim of this research work is to reduce the human effort by implementing the engine to the rear wheel of the cycle. In future the engine will be replaced by some green technology concept.

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