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Design of Internal Combustion Engine Using Quick Return Mechanism

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ABSTRACT

The main aim of our project is to increasing the burning time of fuel by using the method of increasing the time of the power stroke of internal combustion engine by using slotted-lever mechanism (quick return mechanism).Here we use the slotted lever between the crank shaft and the connecting rod in order to implement the quick return mechanism. The concept used here is an hybrid of internal combustion engine and shaper machine .In shaper machine the time of return stroke is lesser than the time of cutting stroke which is used in internal combustion engine to increase the time of the power stroke by increasing the crank angle.

Keywords: I.C Engine, Quick return mechanism, Burning time, Crank angle and Power stroke.

1. INTRODUCTION

An engine is a device which transforms one form of energy into another form. However while transforming energy from one form to another, the efficiency of conversion plays a vital role. Normally, most of engines convert thermal energy into mechanical work and therefore they are called 'heat engines'.

Heat engine is a device which transforms the chemical energy of a fuel into thermal energy and utilizes this thermal energy to perform useful work. Thus thermal energy is converted into mechanical energy in a heat engine. Heat engine can be broadly classified into two categories.

- Internal combustion engine
- External combustion engine

1.1 Internal combustion engine

The combustion of fuel with oxygen of air occurs within the cylinder of the engine. The internal combustion engine group includes engines employing mixtures of combustible gases and air known as gas engines, those using lighter liquid fuel or spirit known as petrol engines and those using heavier liquid fuels known as diesel(compression ignition) engines.

1.2 External combustion engine

The combustion of fuel takes place outside the cylinder as in case of steam engines where the heat of combustion is employed to generate steam which is used to move a piston in a cylinder. Other examples of external combustion engines are hot air engines, steam turbine and closed cycle gas turbine. These engines are generally used for driving locomotives, ships, generation of electric power etc. Reciprocating internal combustion engines offer the following advantages over external combustion engines

- Overall efficiency is high.
- Greater mechanical simplicity.
- Weight to power ratio is generally low.
- Lower initial cost.
- Easy starting from cold condition.
- Compact and require less space.

The external combustion engines claim the following advantages over internal combustion engines

- Starting torque is generally high.
- Cheaper fuels are used.
- Due to external combustion of fuel flexibility is high

2. EXISTING METHOD

A combination of number of bodies assembled in such a way that the motion of one causes constrained and predictable motion to the others is known as mechanism. Thus, the function of mechanism is to transmit and modify a motion. A machine is a mechanism or a combination of mechanism which, apart from imparting definite motion to the parts, also transmits and modifies the available mechanical energy into some desired work. The motive has to be derived from external sources.

Degrees of freedom of a pair is defined as the number of independent relative motions, both translational and rotational of a pair.

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2.1 Slider crank mechanism

A slider crank mechanism converts the rotary motion of the crank into reciprocating motion of the slider or vice-versa. However, when it is used in auto mobile engine by adding valve mechanism. It becomes a machine which converts the available energy into desired energy.

When one of the turning pairs of a four bar chain is replaced by a sliding pair. It becomes a slider crank mechanism. It consists of one sliding pair and three turning pair. It has 4 links connected to each other, the link one corresponds to the frame of the engine, which is fixed. The link 2 corresponds to the crank; link 3 corresponds to the connecting rod and the link 4 corresponds to the piston. As the crank rotates the piston reciprocates in the cylinder.

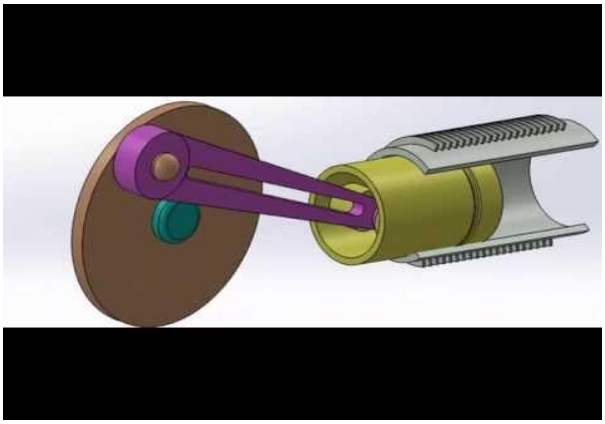

Fig.1. Slider crank mechanism.

3. PROPOSED METHOD

3.1 Inversion of mechanism

Different mechanisms obtained by fixing different links of a kinematic chain are known as inversion. The inversion of slider crank mechanism is crank and slotted lever mechanism.

3.2 Crank and slotted lever mechanism

This is the mechanism used in shaping machine and slotting machine. In this mechanism, the link 3 forming the turning pair is fixed, the link 3 corresponds to the connecting rod of stream engine. The driving crank CB revolves with uniform angular speed above the fixed centre C.

A sliding block attached to the crank pin at B slides along the slotted bar AP and thus causes AP to oscillate about the pivoted point A. A short link PR transmits the motion from AP to the ram which carries the tool and reciprocates along the line of stroke. The line of stroke of the ram (R_1R_2) is perpendicular to AC produced. In the extreme positions, $AP_1$and $AP_2$are tangential to the circle and the cutting tool is at the end of the stroke. The forward and the cutting stroke occur when the crank rotates through an angle β in the clockwise direction. The return stroke occurs when the crank rotates through an angle α in the clockwise direction.

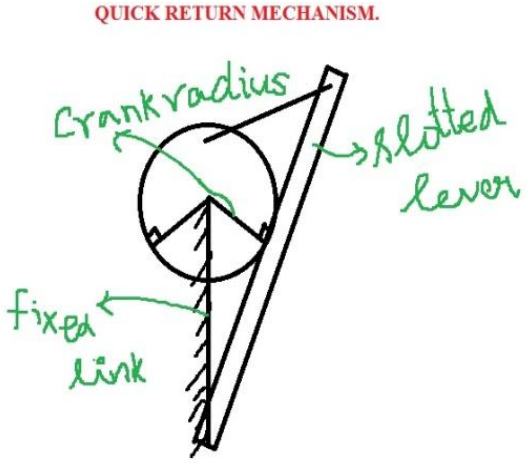

Fig.2. Quick return mechanism

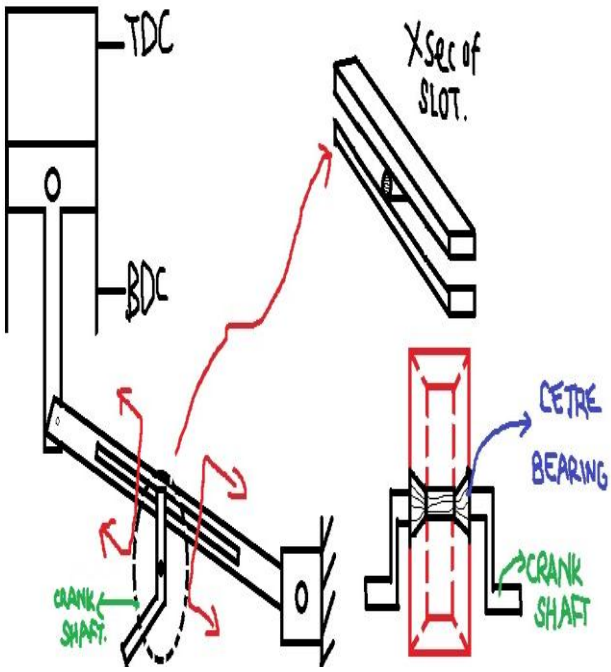

Fig.3. Line diagram of the project

In this type of engine two strokes will be fast and other two strokes will be slow due to the usage of quick return mechanism. The suction stroke and power stroke will be slow and the compression and exhaust stroke will be fast compared to normal engine.

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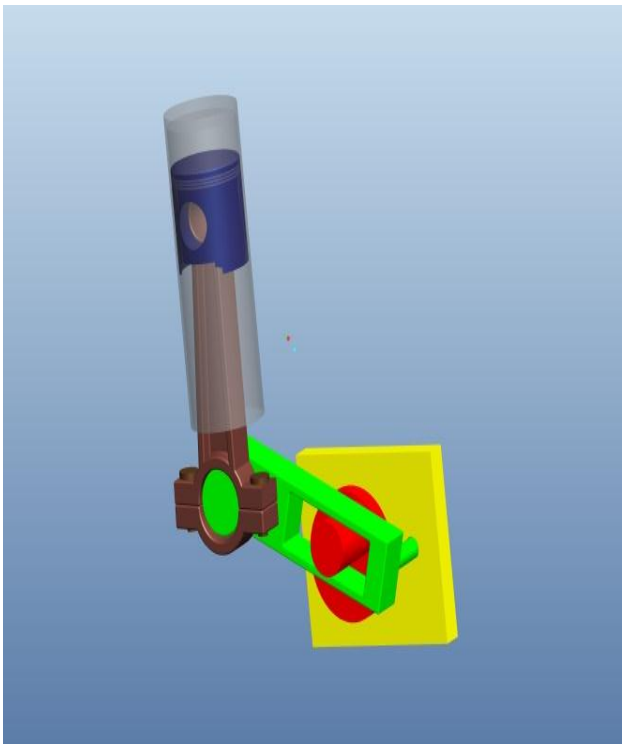

Fig.4. CAD diagram of the project.

4. WORKING

The working model is an integrated mechanism of slider crank and slotted lever mechanism .In this mechanism, the crank slides on the slot of a lever which is fixed at one end and the other end is connected to the connecting rod. The connecting rod is connected to piston by piston pin and piston reciprocates into the cylinder.

Normal IC engine the four strokes takes place at a crank angle of 180^o each. But in this IC engine the suction and power stroke takes place at angle of 234^o and the compression and exhaust stroke takes place in 125^o by the calculations above.

The working model includes the four strokes of normal internal combustion engine with some modifications at crank angle.

The 4 strokes of an engine are:

- Suction
- Compression
- Power
- Exhaust

4.1 Suction stroke

During suction the piston is at TDC and moves towards BDC. The air is sucked into the cylinder during this stroke and inlet valve is open at that time. The pressure within the cylinder is less than the atmospheric pressure. In the IC engine with inbuilt quick return mechanism the crank angle is increased.

4.2 Compression stroke

During compression the piston moves from BDC to TDC in order to compress the air fuel mixture and to increase the temperature. In this stroke the valves are closed. The crank angle gets decreased during this stroke in the IC engine with inbuilt quick return mechanism.

4.3 Power stroke

During power stroke, the piston moves from TDC to BDC in order to expand the stroke. In this stroke the valves are closed. In this stroke power is produced in the engine and stored in flywheel. The crank angle gets increased during this stroke in the IC engine with inbuilt quick return mechanism.

4.4 Exhaust stroke

During exhaust stroke, the piston moves from BDC to TDC to expel the gases out of the cylinder. In this stroke the exhaust valve is opened. The crank angle gets decreased during this stroke in the IC engine with inbuilt quick return mechanism.

4.5 Port and valve timing diagrams

In normal diesel engines inlet valve opens at 10-25^o in advance to TDC position and closes 25-50^o after the BDC position. Exhaust valve opens 30-50^o in advance to BDC position and closes 10-15^o after the TDC position. The fuel injection takes place 5-10^o before TDC position and continues up to 15-25^o near TDC position.

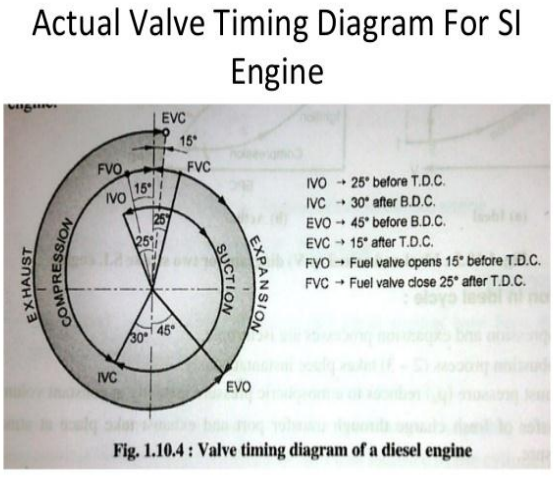

Fig.5. Actual valve timing diagram of I.C engine

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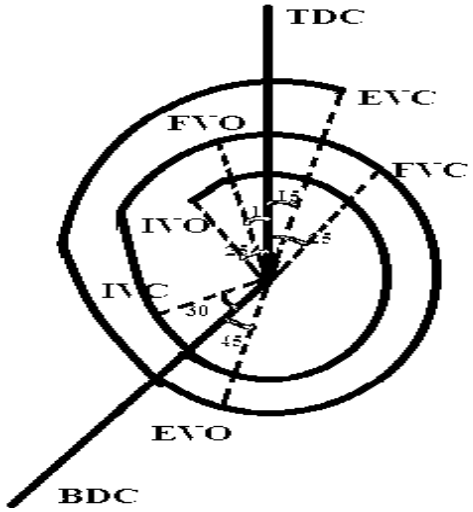

Fig.6. Valve timing diagram for engine with quick return mechanism

In the IC engine using quick return mechanism there will be changes in the BDC position .So, there will be changes in the valve timing diagram of this engine as diagram shows. Results in higher efficiency when compared to normal engines.

5. CONCLUSION

Among the various method of increasing the efficiency of an engine we find new technologies and new methods but this integrated quick return mechanism and slider crank mechanism makes the timing of the power stroke to be increased as there is an increase in the crank angle as the increase in fixed link. There will be an increase in the indicated power but due to various losses there will be a loss in the system these changes as an increase in entropy of the surrounding. This engine reduces entropy increase and results in more available energy of the engine.

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