

MODIFICATION OF FOUR STROKE ENGINE INTO TWO STROKE ENGINE

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ABSTRACT: Nowadays the technology is growing faster than we think in that growing technology the engine development plays a vital role in the field of automobiles. Due to some reasons the use of the two stroke engine is stopped but the power development of the two stroke engine is more. since the four stroke engine have several advantages than two stroke engine in some cases. So, we integrate a four stroke engine with two stroke hence posses higher performance, which means conversion of four stroke engine into two stroke engine by applying some modifications in the working principle. The problems which we are facing in the normal two stroke engine will be no more in our proposed system.

KEYWORDS:, Power development, Modification of four stroke engine, higher performance

I.INTRODUCTION

Now a days two stroke engine is not used because of some disadvantages. i.e. improper combustion, low volumetric efficiency, highly pollutant, high wear and tear. And also four stroke engine takes the place of two stroke engine due to better overall efficiency. But the rate of output power of two stroke engine is high when compared to the four stroke engine. So our proposed idea is to reduce the number of strokes (i.e. two strokes) in the present four stroke engine to achieve two stroke engine power along with the four stroke engine efficiency. The working of this engine is simple as two stroke engine but the actuator valves are used instead of ports. Therefore fuel injector, vacuum pump with controlled ECM are implemented to increase the engine performance.

II. GEOMETRICAL CONFIGURATIONS

The Engine outer casing is same as the present four stroke engine with separate oil sump and pump. The inlet air-fuel mixture and exhaust burned gases are controlled by the actuator valve implemented over the engine head instead of valve train to posses better efficiency. And to provide high volumetric efficiency the multi point fuel injector is mounted over the inlet manifold, so far the vacuum pump in engine is used only for braking purpose. But we are going to use this pump in the exhaust manifold for exhaust removal process to reduce improper combustion which leads to increase in compression ratio. Thus the MPFI system, spark plug and vacuum pump are integrated by an engine crank timing which is to be controlled by a Electronic control module (ECM).

1. Actuator valve:

Actuator are transducers that usually convert electrical signals from the ECM into mechanical motion. Inputs are usually from sensors and switches. Outputs are usually to actuators which then operate switches, valves and other devices.

1.1 Principle of electromechanical valve actuator :

A typical construction of EMV consists of two magnets (closer and opener), two springs (an actuator and a valve spring) and a moving armature that is connected to an engine valve. Normally, most modern engines incorporate a hydraulic lash adjuster to ensure proper valve sealing under all thermal operating conditions. The current flowing in the

coil creates a magnetic force on the armature to overcome compressive spring and friction forces. Both springs are adjusted such that they are always in compression for any armature position between the two electromagnets. Preloading these springs are ideal for achieving rapid flight time and minimizing electrical energy input. During normal operation, the spring forces are utilized to accelerate the moving masses while electromagnetic forces are utilized to attract and dwell the armature.

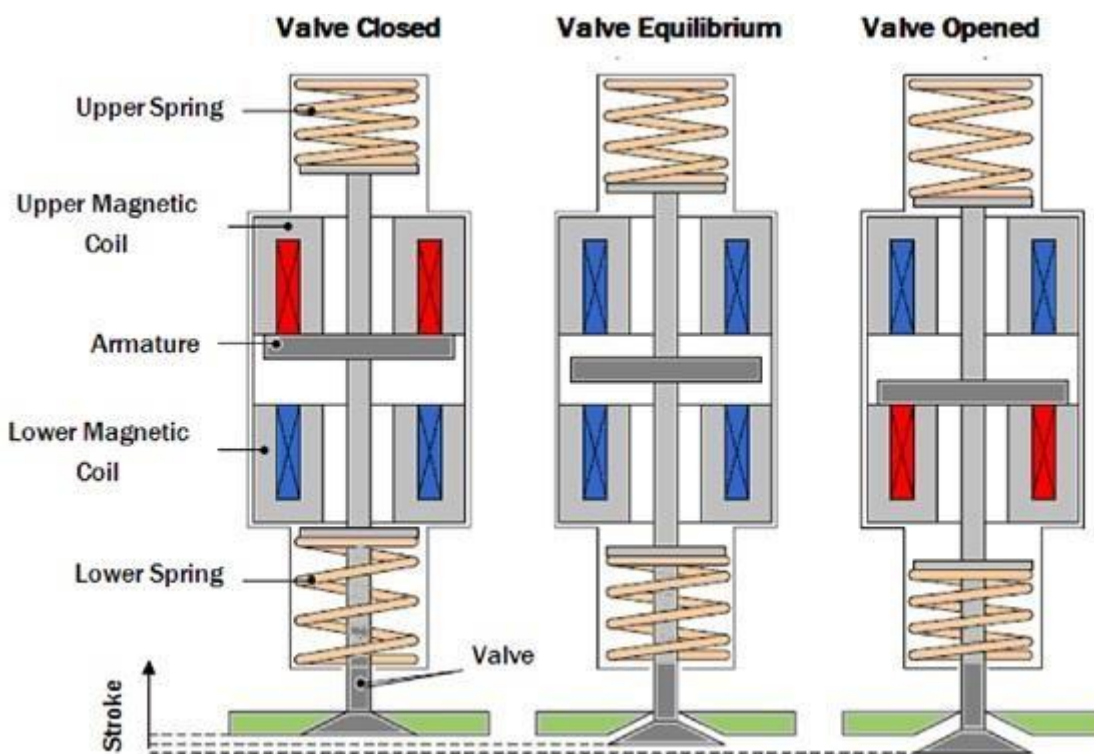


Figure 1. shows a schematic of an EMV actuator mounted on a cylinder head.

Figure 1 shown above illustrates a typical operational mode of the EMV actuator. To move the valve from neutral to closed position, a routine is initialized to impart sufficient armature momentum for the closer coil magnetic forces to attract the armature. Once contact is established and quasi-static conditions are reached, a holding current is applied to the upper coil so that sufficient magnetic force is generated to overcome spring forces while holding the armature and valve in the fully closed position. When the valve is commanded to open, the upper coil current is rapidly discharged, allowing magnetic force to decay and the actuator spring to push the armature down. The lower coil is then activated to capture the approaching armature. The electromagnetic force generated is proportional to the volume of the electromagnet. The design volume of the electromagnet is limited by the area in the cylinder head. Thus a compromise has to be made in the design and operation of an engine using EMV system. This compromise is usually in the form of a limited volumetric efficiency and maximum operating speed of the engine [7, 8]. Table 1 tabulates the varies technical data for Electromechanical valve actuator(EMV) as follow

TABLE 1: Technical data of electromechanical valve (EMV)

Parameters	Symbols	Units	Values
1. The valve mass	m_v kg	0.16	
2. The armature mass	m_a	kg	0.25
3. Supply voltage	V_{app}	voltage	24
4. Permeability in free space.	μ_0	H/m	$4\pi \times 10^{-7}$
5. The resistance of both the wiring and magnetic coil	R	Ω	0.35
6. The valve guide diameter	d_g	m	6×10^{-3}
7. The valve guide length	L_g m	24×10^{-3}	
8. The valve and valve guide Clearance	h m	0.5×10^{-3}	

1.2 Equilibrium of force acting on EMV :

The actuating forces on the valve armature are the magnetic, spring, inertia and frictional forces, in addition to the gas pressure force from the engine cylinder, the magnet force is applied to the valve directly through the armature. When no magnetic force exists, the armature is held by the upper and the lower spring in the middle position between the two magnets. This condition occurs when the engine is shut off. During engine operation, a current in the coil of the upper magnet is used to hold the armature against the upper magnet so that the valve is in the close position (equilibrium). To open the valve, the current is interrupted and the armature is moved by the spring-forces to the lower magnet. By providing a current to the coil of the lower magnet, the losses during the movement are compensated and the valve is held in the open position. To close the valve, the current is interrupted in the lower magnet and the current is re-applied to the coil of the upper magnet. Figure 2 shows that the equivalent circuit diagram of the electrical coil(EMV) subsystem and Table 2 tabulates the main parameters of electromagnetic model data as follow

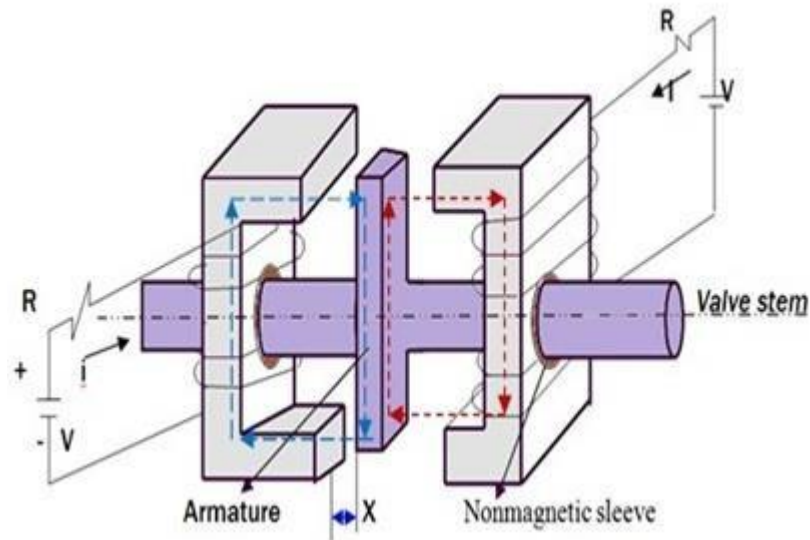


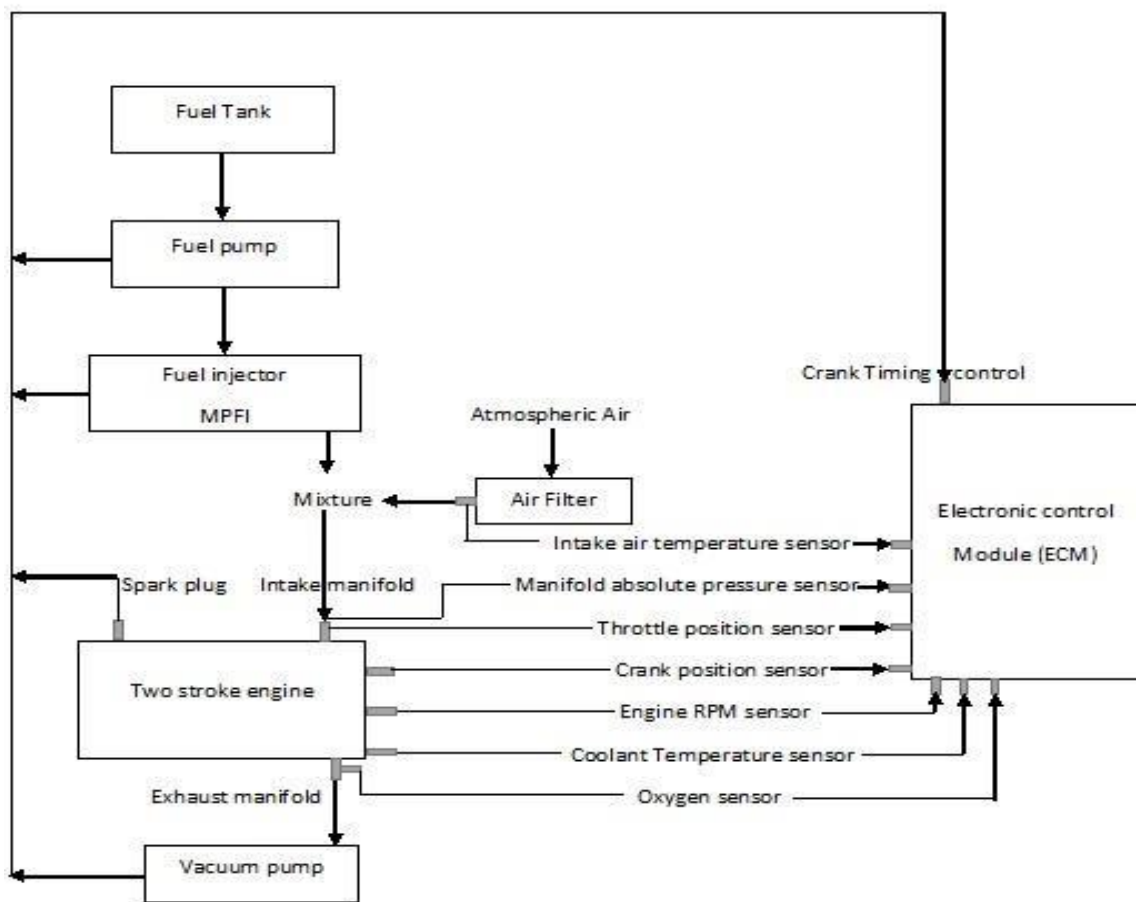
Figure 2. Equivalent circuit diagram of the electrical coil (EMV) subsystem.

TABLE 2 : Main parameter of electromagnetic model data

Parameters	Symbols	Units	Values
1. The maximum valve displacement (lift)	x_v	m	6×10^{-3}
2. The upper spring stiffness	K_u KN/m		75
3. The lower spring stiffness	K_L KN/m		75
4. The valve stem stiffness	K_m KN/m		250
5. Viscous damping coefficient between armature and sleeve	C_m N.s/m		60
6. Viscous damping coefficient between valve and guide.	C_L N.s/m		60.

1.3 Vacuum pump :

The vacuum pump is a device used to suck the burned gas from the combustion chamber. Without using of vacuum pump leads to mixing of exhaust gas and fresh air-fuel intakes in our proposed two stroke engine. And also fresh air-fuel will pass out of the combustion chamber which cause a high fuel consumption and less volumetric efficiency. Figure 3 illustrate the schematic layout of the modified two stroke engine as follows.



3: Schematic layout of the modified two stroke engine.

Figure

III. WORKING PRINCIPLE OF MODIFIED TWO STROKE ENGINE

The modified two stroke engine working is also like two stroke working principle and some device are used to increase the efficiency.

Suction stroke :

During suction stroke , the piston travels from TDC to BDC hence the vacuum will create inside the combustion chamber. Due to this vacuum, the fresh air-fuel mixture will drawn into the combustion chamber by the Multipoint fuel injection system(MPFI).

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Compression stroke :

During compression stroke , both the inlet and exhaust valves are in closed condition .The piston travels from BDC to TDC, Therefore the fresh air-fuel will get compressed into the chamber by the piston upwards movement. It leads to increase in pressure and temperature of the mixture instantaneously.

Expansion stroke :

During expansion stroke , both the inlet and exhaust valves are in closed condition. The compressed air-fuel mixture get ignited by the spark plug due to the high pressure and temperature developed inside the chamber. The rise in pressure of the combustion exert an impulse on the piston and pushes it downwards which is used to rotate the crank once with high power.

Exhaust stroke :

During exhaust stroke , the exhaust valve open and inlet valve is in closed condition. The exhaust gases get trapped by the vacuum pump provided in the exhaust guide way which is used to increase the volumetric efficiency and to decrease the improper combustion in the proposed two stroke engine.

The exact movement at which each of the valves open and close with reference to the position of the piston and crank can be shown graphically in a “Theoretical Solenoid valve timing diagram” .

VI. THEORETICAL SOLENOID VALVE TIMING DIAGRAM OF THE TWO STROKE PETROL ENGINE (S.I)

In theoretical valve timing diagram, inlet and exhaust valves open and close at both the dead centres. Similarly, all the processes are completed at the TDC or BDC. Figure 4 shows theoretical solenoid valve timing diagram for modified two stroke petrol S.I engine.

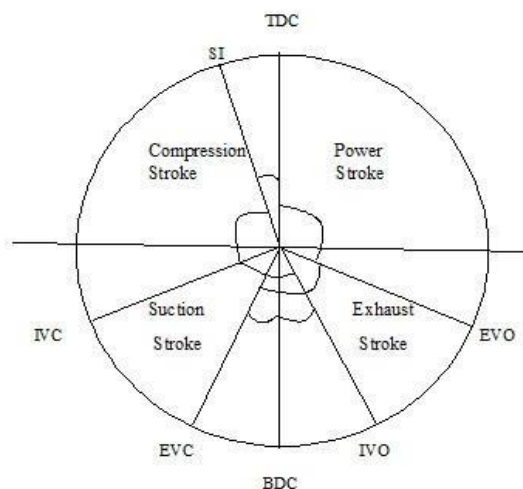


Figure 4 : Theoretical solenoid valve timing diagram

Where,

- IVO – Inlet valve opens
- IVC – Inlet valve closes
- IS – Ignition starts
- EVO – Exhaust valve opens
- EVC – Exhaust valve closes
- TDC – Top dead centre
- BDC – Bottom dead centre

Explanation:

The above figure shows the solenoid Theoretical valve timing diagram for the two stroke S.I engine. The *inlet valve opens* before BDC. The air fuel mixture is drawn into the cylinder till the *inlet valve closes* after the BDC. The mixture is compressed till the spark is occurs. The *spark* is produced before TDC. It gives sufficient time to burn the fuel.

The pressure and temperature increases. The burnt gases are expanded till the valve opens. The *exhaust valve opens* before the BDC. The exhaust gases are sucked from the cylinder by the vacuum pump till the exhaust valve closes. The *exhaust valve closes* after BDC. The period between inlet valve opening and exhaust valve closing is known as *The angle of valve overlap*.

The following Figure 5 illustrate the graphical representation of effective power between the two stroke and four stroke engine at same volume and RPM.

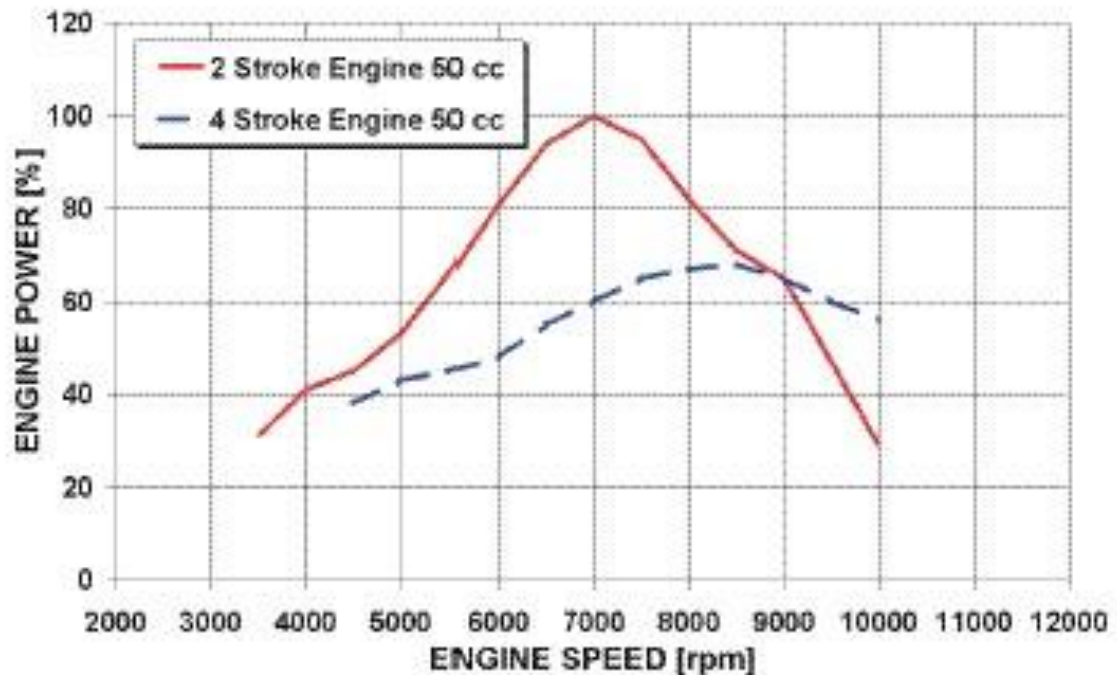


Figure 5: Percentage difference of the effective power between two stroke and four stroke engine

Fig

Advantages:

1. **High power :** The two-stroke cycle engine gives one working stroke for each revolution of the crankshaft. Hence theoretically the power developed for the same engine speed and cylinder volume is twice that of the

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four-stroke cycle engine, which gives only one working stroke for every two revolutions of the crankshaft. However, in practice, because of poor scavenging, only 50-60% extra power is developed.

2. **Flywheel requirement:** Due to one working stroke for each revolution of the crankshaft, the turning moment on the crankshaft is more uniform. Therefore, a two-stroke engine requires a lighter flywheel.
3. **Reduced component:** Owing to the absence of the cam, camshaft, rockers, etc. of the valve mechanism, the mechanical efficiency is higher.
4. **Oscillations:** The two-stroke engine gives fewer oscillations.
5. **Lubrication:** It consumes lesser wear and tear due to the separate oil pan installed in the engine casing.
6. **Compression ratio:** Since the vacuum pump is used in our proposed system to trap the exhaust burned gases, so, the dilution of the charges doesn't take place which results in better thermal efficiency and possesses good volumetric efficiency. Hence, the compression ratio of this engine is higher. As the efficiency of an engine is directly proportional to its compression ratio, the efficiency of a modified two-stroke cycle engine is better.

V. CONCLUSION

The following conclusions are drawn from the studies conducted.

1. Thus the theoretical concept of the modified four stroke into two stroke I.C engine possesses higher power compared to the four stroke I.C engine.
2. Turning moment developed is more uniform and hence lighter flywheel is required.
3. Due to the actuator valve, fuel injector and vacuum pump installed in the modified two stroke engine it possesses high volumetric efficiency and better compression ratio.

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