A Technical Review on Study and analysis of six stroke internal combustion engine

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***Abstract*—**This paper deals with the analysis of six stroke combustion engine, its design, operating and advantages of this kind of engine. The six stroke engine delivers additional power and inflated thermal potency than the modern, wide used four stroke engines. the two further strokes are the fifth stroke i.e., water injection stroke and also the sixth stroke i.e., exhaust stroke. in a very six stroke engine power is delivered double in one cycle of six strokes. By capturing the exhausted heat from the four stroke cycle and victimization it to use further power and exhaust stroke therebyproviding a pair of power strokes eight over in a very four stroke engine. Reduced fuel consumption and high thermal effectiveness are advantageous in six stroke engine.

***Key word*—** *Six Stroke Engines, combustion, heat, efficiency etc.*

1.Introduction

A six-stroke burning engine is meant to deliver additional power with magnified thermal strength and reduced fuel consumption. [1] This engine has six strokes per cycle and have similar parts as that of 4 stroke engine however acquire two more valves. Six stroke engines are utilized in serious load-carrying vehicles wherever focus is on load carrying ability than fuel economy. The two further strokes in these engines increase the work extracted per unit input of energy that causes associate degree energy strength of up to half-hour above that of 4 stroke engine. [2] the highest and bottom portion of six stroke engine is analogous to the two and four stroke severally. The crower stroke engine, fictional by Bruce Crower from USA; the Bajulaz engine [3] by the Bajulaz SA company of Switzerland; and therefore the Velozeta six stroke engine [4] designed by the school of Engineering at Trivandrum in Asian country are the new styles.
The six-stroke motor discusses a range of IC motor methods to use and produce more energy from waste heat from the 4-stroke diesel cycle or Otto cycle. The one compression and one power stroke are generally added to the cycle, which increases the thermal efficiency and reduces fuel consumption. The six-stroke piston moves six times for each fuel injection
After the exhaust the fuel-air mixture is again compressed and burned gases are removed during the sixth stroke, the first four strokes are the same as the 4-stroke engine. The glowing combustion chamber enables fuel to be burned optimally and the residues to be calculated.
The primary stroke of the six-stroke cycle, for example the confirmation of the air or of the air-fuel blend, includes just low weight confirmation chambers. The third and fourth strokes of this equivalent cycle, for example the second pressure and the primary development of the burning gases separately, include just high weight burning chambers. The last release of the ignition gases under low weight, which speaks to the 6th stroke of the cycle, includes just low weight affirmation chambers and low weight release chambers The motor shows 30-40 % decrease in fuel utilization and furthermore efficient. The motor can likewise use variety of fuel. As the motor has two forces stroke that gives the productive consuming of the fuel and bring down the infectivity.

2-Types of Six Stroke Engine

A single cylinder engine design.
These designs use a single piston per cylinder, like a conventional two-stroke or four-stroke engine. A secondary, no detonating fluid is injected into the chamber, and the leftover heat from combustion causes it to expand for a second power stroke followed by a second exhaust stroke.

1-Griffin six-stroke engine

Heated exhaust-jacketed external vaporizer, into which fuel was sprayed, was the main principle of working of griffin six stroke engines. The temperature was held around 550 °F, sufficient to vaporize the oil but not to break it down chemically. This fractional distillation supported the use of heavy oil fuels, the unusable tars and asphalts separating out in the vaporizer.

2-Bajulaz six-stroke engine

The Bajulaz six-stroke engine is similar to a regular combustion engine in design. There are, however, modifications to the cylinder head, with two supplementary fixed capacity chambers: a combustion chamber and an air preheating chamber above each cylinder. The combustion chamber receives a charge of heated air from the cylinder; the injection of fuel begins an isochoric (constant-volume) burn which increases the thermal efficiency compared to a burn in the cylinder.

3-Velozeta six-stroke engine

In a Velozeta engine, fresh air is injected into the cylinder during the exhaust stroke, which expands by heat and therefore forces the piston down for an additional stroke. The valve overlaps have been removed and the two additional strokes using air injection provide for better gas scavenging.

4-NIYKADO Six Stroke Engine

This is the only engine that is categorized as a fully working prototype. The first prototype was developed in 2004, which used only two valves. The second prototype, developed in 2007, was an improved design using four valves.

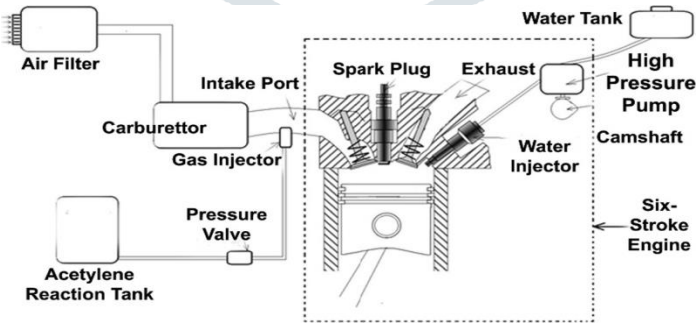
5-Crower six-stroke engine

In a six-stroke engine prototyped in the United States by Bruce Crower, water is injected into the cylinder after the exhaust stroke and is instantly turned to steam, which expands and forces the piston down for an additional power stroke. Thus, waste heat that requires an air or water cooling system to discharge in most engines is captured and put to use driving the piston.

3 - component of six stroke internal combustion engine.

The following component are used in six stroke internal combustion engine in which six stroke take place.

1. Intake valve
2. Heating chamber valve
3. Combustion chamber valve
4. Exhaust valve
5. Cylinder
6. Combustion chamber
7. Air heating chamber
8. Wall of combustion chamber
9. Fuel injector
10. Heater plug



Schematic diagram of six stroke engine

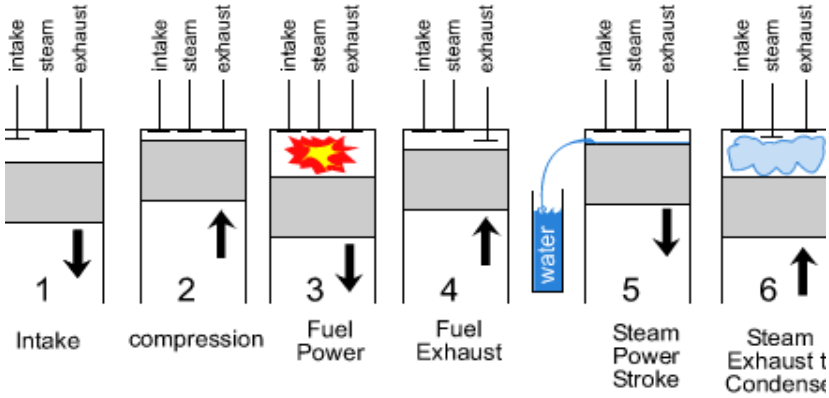
4-Working Principle of Six Stroke Engine

Stroke-1

The inlet valve is kept open. Due to cranking, Piston moves downward which results in the formation of a pressure difference due to which pure air enters the cylinder.

Stroke-2
The inlet valve closes and the heating chamber valve opens. The piston moves upward due to cranking forcing air into heating chamber. The air at this stage is converted to high pressure.
Stroke-3
The combustion chamber valve opens and gases of combustion enter the cylinder.

Stroke-4
The exhaust valve opens. The piston moves upwards and the exhaust gases are removed via this valve.
Stroke-5
The chamber valve opens and the pure air now at high pressure and high temperature enters the cylinder which
does work on the piston and hence it moves downward resulting in the 2nd power stroke.
Stroke-6 Finally the combustion chamber valve opens. The piston moves upwards forces the pure air into the combustionchamber. [4]

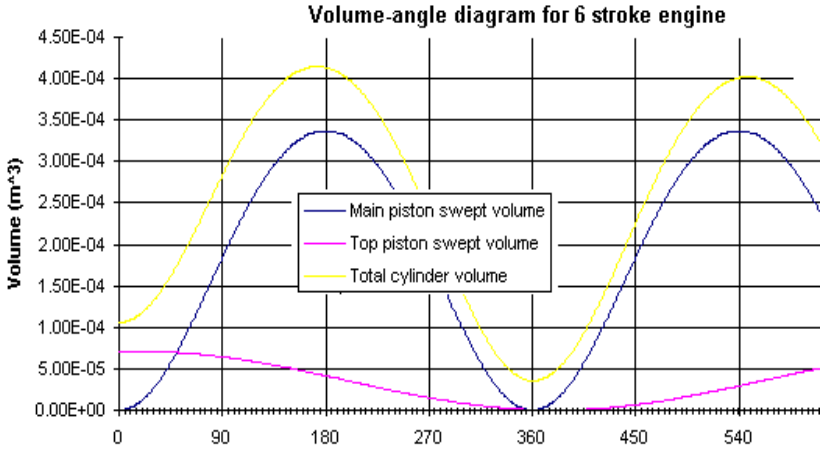


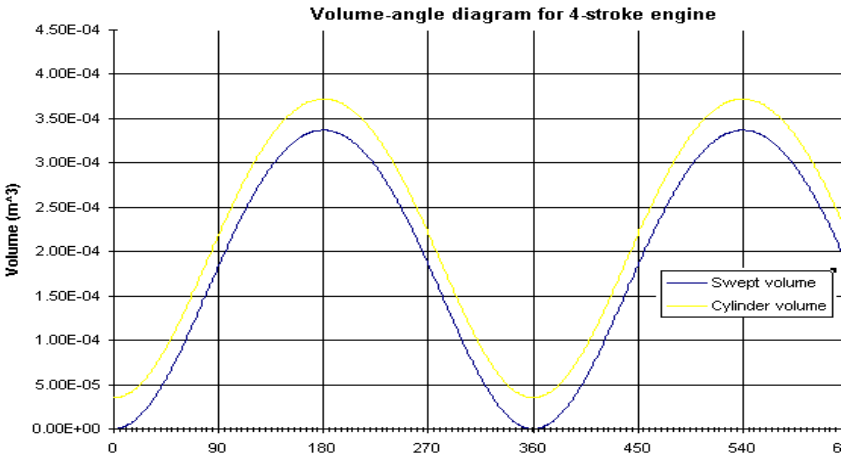
5-Basic Modifications

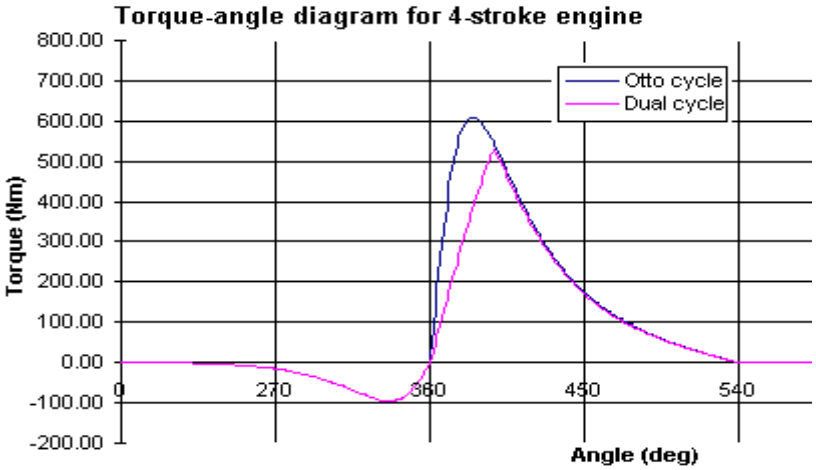
A. Cam Follower Modification: The flat pattern on bottom of shape of the regular follower is suitable with the normal camshaft [10-11] for four stroke engines. The shape of the follower is changed from flat to roller or spherical shape while reducing the duration of valve opening.

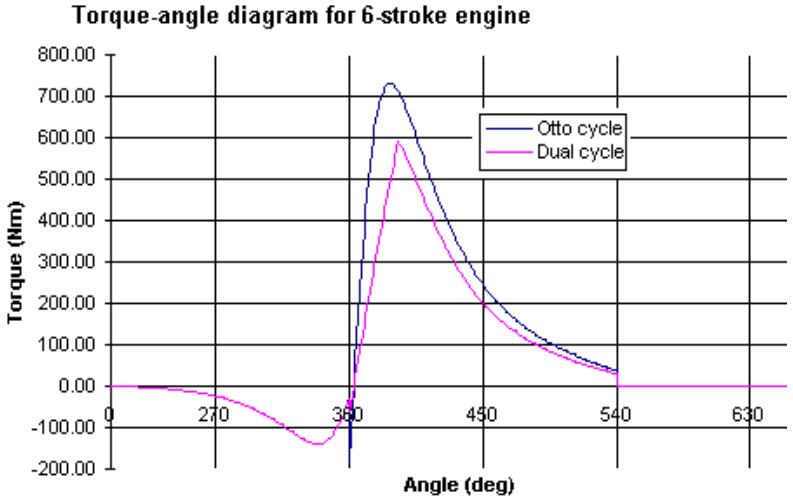
B. Camshaft Modification: The piston moves three times up and down in six stroke engine. Hence, the valve opens two times in one revolution of a complete cycle. The exhaust cam occupies 2 lobes to open the exhaust valve at the fourth stroke and to push out the steam at the sixth stroke.

C. Crankshaft To Camshaft Speed Ratio Modification: The angular speed of the crankshaft is twice that of the camshaft, such that the camshaft rotates once for every two revolutions of the crankshaft. [12-13] The camshaft pulley of the four stroke engine has a 42 tooth and the crankshaft pulley of four stroke engine has 21 tooth . For six stroke engine, the crankshaft rotates 1080 ^{0} to complete one cycle while in four stroke engine, it rotates 720^{0}.









COMPARISON BETWEEN 4-STROKE AND 6-STROKE

	Based on Otto Cycle		
			Total Torque
4 stroke			49.82
6 stroke	*Main*	*Top*	
	56.78	4.61	61.38
	Increase in torque		23.20%

	Based on Dual Cycle		
			Total Torque
			39.36
	Main	*Top*	
	38.66	4.21	42.87
	Increase in torque		8.93%

Advantages Of Six Stroke Engine

1. No external cooling required
2. Reduction in fuel consumption
3. Reduction in pollution
4. Two work cycles in six strokes [14-16]
5. Increased stroke volume
6. Adaptability to various fuels

Disadvantages Of Six Stroke Engine

1. High initial cost due to change in gear structure
2. High manufacturing cost
3. Increased engine size due to additional strokes

CONCLUSION

Today we are facing a huge energy crisis. The only way to tackle this problem is by inventing and designing new technologies with better efficiencies and implement them. The most important aim of the automotive industry is to have an engine with better performance, reduced polluting emission and improved thermal efficiency, this aim can be successfully fulfilled with the help of six stroke engine. Almost 40%-50% reduction in fuel consumption and 60%-70% reduction in polluting emissions can be achieved by implementing six stroke engines.

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