Theory and Review on the 6-stroke Engine

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Abstract— A6-stroke engine is two stroke powered engine. The engines ingest less fuel and deliver high power as compare to the existing engine. Lot of research and development is going on nowadays for improvement, commercialization and alternate fuel. The 6-stroke engine requires little alteration in crankshaft, cam and follower for generating two more strokes. The main advantages of 6-stroke engine are the energy ingestion is less because of slow acceleration of rotating parts. Reduction in fuel consumption, reduction pollutants up to 65%, Lower engine temperature so easy to maintain the optimum engine temp. Level for better performance. In this paper the concept, theory and the comparative discussion on 6-strokeengine is done.

Key words: Six-Stroke, Less Fuel, Camshaft, Energy Ingestion

I. INTRODUCTION

The 6-strokeengine is a type IC engine with an elevated feature of more power generation some ramification intended to make it more efficient and utilize the fuel. These engines almost consist of similar components as that of the 4- stroke engine with addition of two more valves. The working concept is alike to the existingIC engine as a reciprocal movement which is converted into a rotating movement by means of a connecting rod and of a crankshaft.

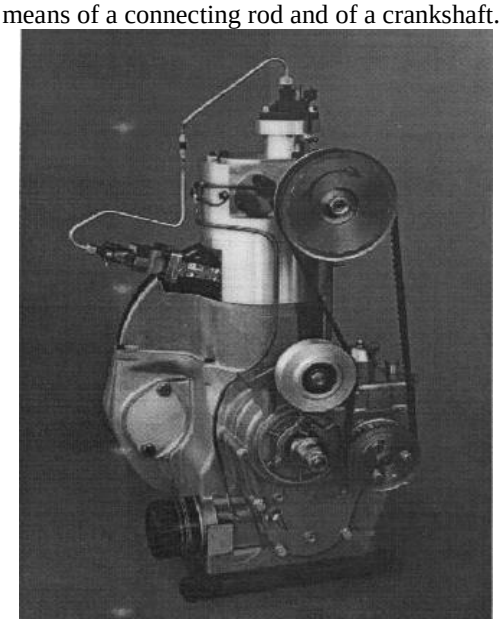

Fig. 1: Prototype of 6-stroke engine

The 6-stroke engine is acombination of 2 and 4-strokeengine that the top portion of 2-stroke engines and the bottom rather the middle section of a 4-strokeengine. In 6-strokecycle, two collimate functions occur in 2area which result in 8 event cycle: 4 events internal combustion cycle and 4 event external Combustion cycles.

The term 6-stroke engine describes 2access in the IC engine, developed since the 1990s, to enhance its efficiency and reduce emissions.

In the 1st access, the engine absorb the waste heat from the 4-stroke Otto cycle or Diesel cycle and claim it to get more power and exhaust stroke of the piston in the same cylinder. The 6-stroke engine in this class are the

- Crower's 6-stroke engine, invented by Bruce Crower of the U.S.A;
- the Bajulaz engine by the Bajulaz S A Company, of Switzerland; and
- TheVelozeta‟s6-strokeengine built by the College of Engineering, at Trivandrum in India.

The 2ndaccess to the 6-stroke engine uses a 2ndmatched and opposite piston in each cylinder which displaces at half the cylindrical rate of the main piston, thus giving 6 piston movements per cycle.

- The Beare Head engine, invented by Australian farmer Malcolm Beare, and
- The German Charge pump, invented by Helmut Kottmann.

II. WORKING OF 6-STROKE DIESEL ENGINE

There are two type of 6-stroke engine on work. The first one is where the two strokes are added in between the 4 stroke and the second is type is where two strokes are added after the all four strokes. The 6-stroke engine has consist of the six processes in a complete cycle. These six processes are as

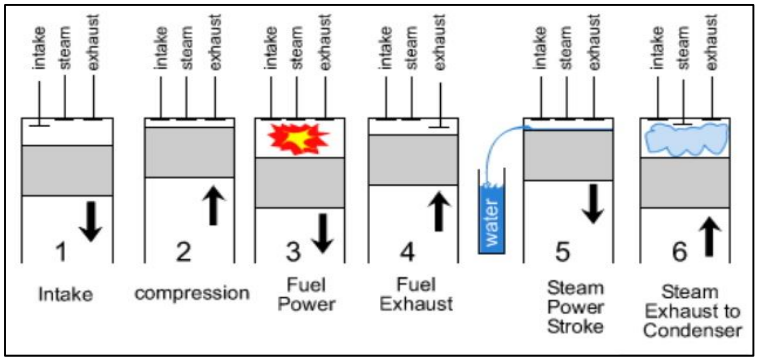

Fig. 2: Working

A. 1st Stroke

To start with the piston is at T.D.C., the inlet valve is open and the exhaust valve is closed. A rotation is given to the crank by the energy from flywheel or by a starter when the engine is just being started. The piston Displaces from TDC to BDC, air-fuel mixture r is absorbed into the cylinder through the inlet valve.

B. 2nd Stroke

During the 2ndstroke, the inlet valve closes up and the heating area valve opens up and piston displacesup due to cranking, forcing air into heating area. The air in this stage is converted to high pressure.

C. 3rd Stroke

During the 3rdstroke, power is obtained from the engine by igniting the compressed air- fuel mixture using a spark plug. Both valves remain closed. Piston displaces from TDC to BDC. Now we can simply says the combustion area valve opens and gases of combustion enter the cylinder.

D. 4th Stroke

During the 4thstroke, the exhaust valve opens up to remove the combusted gases via this valve. From the engine cylinder Piston displaces from BDC to TDC.

E. 5th Stroke

During the 5thstroke, the exhaust valves stays close and the water Inlet valves open. Through water inlet valve fresh water enters the cylinder via secondary water initiation system. Piston displaces from TDC to BDC.

F. 6th stroke (Second Exhaust Stroke)

During the sixth stroke, the water exhaust valves staysopen. The water blew into the cylinder during the fifth stroke is removed to the atmosphere through the water exhaust valve and 6-strokes are completed.

III. TYPES OF 6-STROKE ENGINE

The 6-strokeengine is basically divided into 2-types as listed below:

A. Single Piston Designs

- Griffin 6-stroke engine
- Bajulaz6-stroke engine
- Crower 6-stroke engine
- Velozeta6-strokeengine.

B. Opposed Piston Design

- Beare head
- M4+2
- Piston charger engine

1) Single Piston Designs

It's a single piston cylinder just the regular stroke engine. A non-exploding fluid is ingested into the cylinder and the remainder heat from the combustion expands it for 2nd power stroke.

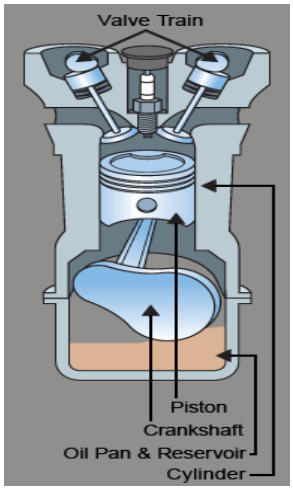

Fig. 3: Single Piston Cylinder

2) Opposed Piston Design

In this type of design two piston head to head is used with combustion occurring between the two.

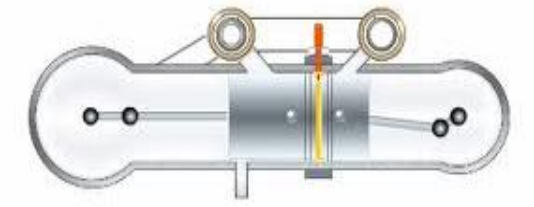

Fig. 4: Opposed piston cylinder

IV. ALTERATIONS IN 6-STROKE ENGINE

The alteration required in parts like crank, camshaft and cam follower for converting a 4 -stroke engine into 6-stroke are listed as follows

A. Crankshaft to Camshaft Ratio Alteration

The gear of the crankshaft in 6-strokemust rotate to 1080^0 in order to rotate the camshaft 360^0.
Hence the compression of 6-stroke engine is little bit higher 3:1.

B. Camshaft Alteration

The exhaust cam has two lobes to open exhaust valve at 4^{th} stroke and at 6^{th} stroke to remove the steam. To use this configuration the cam rotation of 360^0 is divided into 60^0 in all 6-stroke.

C. Cam Follower Alteration

The follower is modified flat to roller or spherical shape in order to reduce the valve opening time.

V. BETWEEN 6-STROKE AND 4-STROKE ENGINE

After applying these alterations on the engine, a test was carried out to be surethat the engine runsfluently with 6-strokes instead of 4-strokecycles. A general result of previous studies is presented here which compares p-v and torque between 4-stroke and 6-stroke.

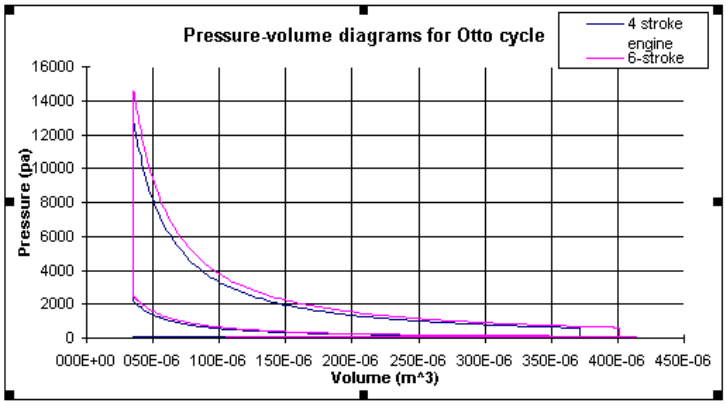

Fig. 5: 4-Stroke & 6-Stroke

Following points can be concluded from the test took by the previous studies:

- In a 6-stroke engine the energy ingestion is less because of easy acceleration of moving parts.
- It reduces the mass of the engines head by as much as 50%. Instead of using energy to drive the head.
- Torque is increased by 35% and efficiency increased by the same.
- Increased torque and power output.

COMPARISON BETWEEN 4-STROKE AND 6-STROKE

	Based on Otto Cycle			Based on Dual Cycle		
			Total Torque			*Total Torque*
4 stroke			49.82			39.36
	Main	*Top*		*Main*	*Top*	
6 stroke	56.78	4.61	61.38	38.66	4.21	42.87
	Increase in torque		23.20%	Increase in torque		8.93%

Fig. 6: Comparison between 4 Stroke & 6-Stroke

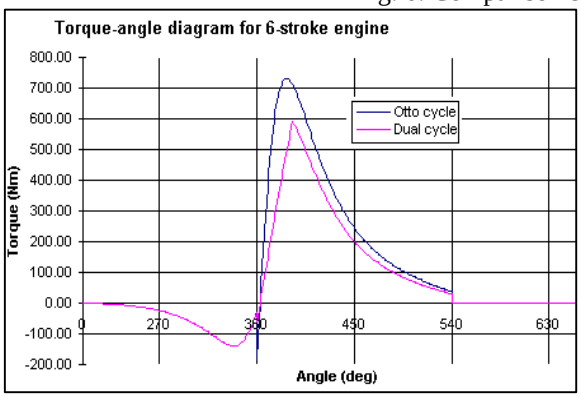

Fig. 7: Torque angle diagram for 6 stroke engine

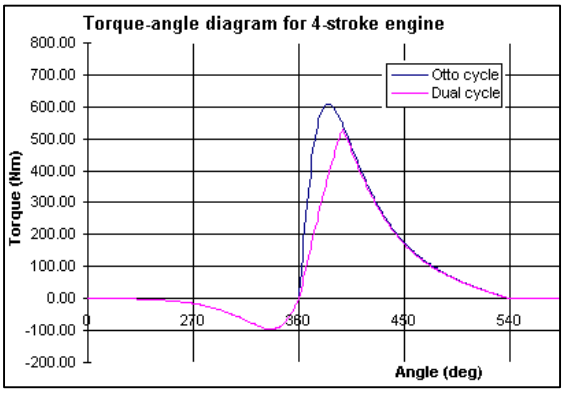

Fig. 8: Torque angle diagram for 4 stroke engine

VI. MERITS OF THE 6-STROKE ENGINE

A. Low Fuel Ingestion

Due to increase in thermal efficiency cover the specific power part in 6-strokewhich creates low fuel ingestion.

B. Various Types of Fuel Intake

Due to flammability difference the problem of combustion is reduced. Hence it gives more types of fuel options all the way form petrol diesel to LPG and animal grease.

C. Two Expansions (Work) in 6-Strokes

The work cycle take place in 2 stroke the torque generated in very much even which reduces emission and provides smooth performance.

D. Decrease in Pollution

Decrease in pollutants, chemical and noise can be easily seen in 6-stroke engine.

VII. DEMERITS OF THE 6-STROKE ENGINE

The 6-stroke engine possess some demerits also which are listed below

1) head design is complex
2) due to 2 exhaust stroke cam design also get little complex
3) engine becomes heavier
4) requires large time to design the new parts

VIII. CONCLUSION

The new invention of the 6-stroke engine is a better option to replace or work with 4-stroke engine as it helps in progress with less time and money. Ina 6-stroke engine the energy ingestion is less because of easy acceleration of moving parts. 6-stroke offer better working comfort due to even torque generation which in turn help to reduce emission pollutant. The new stroke engine also offers various types of fuel as ingestion which opens wide area of research and development for the heart of any automobile.

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