Six Stroke Engine

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Abstract— In the need of high-efficient engines for current century the most possible challenge in the engine technology today is the need to increase engine efficiency. The engine will be more efficient when its fuel consumption and atmospheric emissions are less and work done output is more. A six stroke engine can be considered as one of them. It is basically a four strokes cycle followed by a two additional strokes. In this engine the power is obtained two times in a cycle of six strokes. This engine has tremendous and huge scope of development and various applications. Lot of research work has been conducted on this topic now a days. Six stroke engine's adoption by the automobile industry would have a tremendous impact on the environment and world economy.

Key words: Six Stroke Engine, fuel consumption

I. INTRODUCTION

As the time passes, it is believed that the petroleum products and crude oil will be not enough and will be costly. However the demand and availability of petrol and diesel is somewhat unbalanced. If the same situation continues then the scenario will be more disastrous and fuels will be more costly and limited. The six-stroke engine, a kind of internal combustion engine with an advance feature of more power generation is used to make it more efficient and utilize the fuel judiciously, which will be the small step towards safe future situation. The basic working fundamental is same as the actual internal reciprocating combustion engine as a reciprocal movement which is converted into a rotating movement by means of a connecting rod and of a crankshaft. Alternatively this engine is thermodynamically more efficient.

According to its mechanical design, combustion does not occur within the cylinder but in the additional combustion chamber, does not act immediately on the piston, and its duration is independent from the 180^0 of crankshaft rotation that occurs during the expansion of the combustion gases. The combustion chamber is totally enclosed within the water heating chamber. By heat exchange through the combustion chamber walls, steam formed in the water chamber generate power for the additional working stroke. Design use steam as the working fluid for the additional power stroke. With the help of hot gases the water changes its phase into steam as the temperature of the hot gases is high. This steam will works as a working fluid which will forces the piston downwards. The piston in this engine goes up and down six times for each fuel-air mixture intake. Thus this engine has two power strokes: one by fuel, and other by steam. So this combination of two stroke and four stroke technology is named as "six stroke engine".

II. WORKING PRINCIPLE

The basic working principle of six stroke engine is carried out as, fuel is taken from the fuel tank into the cylinder, and combustion takes place with the help of spark plug. Heat generated is transferred to water combustion chamber were the water gets directly converted into the steam and this steam is passed into the cylinder to obtained the first power stroke. The second power stroke is obtained from the burnt gases which is finally exhausted from the cylinder. The above mentioned process is performed by the cam shaft which is provided with an additional lobe on each cam and it is rotated at a speed of 1/3 that of the crankshaft speed for very three revolutions of the crankshaft. First power stroke is obtained from secondary fuel that is water and second power stroke is obtained from primary fuel that is petrol or diesel which finally results into increasing the overall efficiency of engine.

III. WORKING OF SIX STROKE ENGINE

In a six stroke engine, just before the third stroke fresh water is injected directly into the water combustion chamber through the water injector pump, which is quickly turned into a superheated steam, which causes the water to expand to 1600 times its volume and forces the piston down for an additional power stroke. The brain of this engine is its various strokes that take place during the operating condition are:

A. First Stroke (Suction Stroke):

During this stroke, the inlet valve opens, air-fuel mixture enters the cylinder from the carburetor through the intake manifold and the piston moves in downward direction.

B. Second Stroke (Compression Stroke):

During the second stroke, the charge is compressed and piston moves in upward direction, both the inlet valve and exhaust valves are closed and heating chamber valve is opened.

C. Third Stroke (Steam Power Stroke):

Spark is given to the charge and heat exchange occurs between the combustion and water chambers walls, without direct action on the crankshaft and expansion of the superheated steam in the cylinder takes place and thus obtaining first power stroke.

D. Fourth Stroke (Exhaust Stroke for steam):

In this stroke steam exhaust valve open and allows to escape the exhaust of steam.

E. Fifth Stroke (Gas Power Stroke):

During the fifth stroke, combustion chamber valve opens and the combustion products at high pressure is released into the cylinder which gives the second power stroke. During this process piston moves in downward direction.

F. Sixth Stroke (Exhaust Stroke):

During the sixth stroke, piston moves in upward direction and the exhaust valve is opened to release all the exhaust gases present in the cylinder.

IV. CONSTRUCTION DETAILS:

During the combustion and the water heating processes, the valves could open under the pressure within the chambers. Being a six-stroke cycle, the camshaft speed in one third of the crankshaft speed. The combustion chambers walls are glowing when the engine is running. A small thickness is provided which allows heat exchange with the water heating chamber, which is surrounding the combustion chamber. The water heating chamber is isolated from the cylinder head to reduce thermal loss.

As the work is distributed over two power strokes, will result in less pressure acting on the piston and greater smoothness of operation and increased service life of the engine. In addition, since the combustion chamber is isolated from the cylinder by its valves, the moving parts, especially the piston, are not subject to any excessive stress from the very high temperatures and pressures. They are also protected from explosive combustion or auto-ignition, which are observed on ignition of the air-fuel mixture in petrol or diesel engines. The combustion and water heating chambers have different compression ratio.

V. PERFORMANCE TEST

Two tests i.e., Engine load test and Pollution test was conducted on the six stroke engine and on the same four stroke engine from which various conclusions are made. The load test was conducted using brake drum dynamometer. The final drive shaft from the engine to the wheel was used for loading during the experiment. The engines were tested for various rpm under the same loading conditions. The time for consumption of 10cc of the fuel was noted during the experiment. The % volume of CO in exhaust gas during idling was tested to check the pollution level of the engines.

A. Load test reading:

Sr.no	Observations	1	2	3	4	5
1	Load, W in kg	0	0	0	0	0
2	Speed, N in rpm	900	1200	1500	1800	2000
3	Volume of fuel, V_f in m^3	10^{-5}	10^{-5}	10^{-5}	10^{-5}	10^{-5}
4	Fuel consumption time, t_f in sec	42	34	30	26	24

Table 1:

B. Load Test Result:

Speed (RPM)	Brake thermal Efficiency (%)	
	4-stroke engine	6-stroke engine
900	28.92	32.78
1200	29.14	35.38
1500	29.93	39.02
1800	30.23	40
2000	31.28	41.65

Table 2:

C. Graph Between Efficiency and Speed

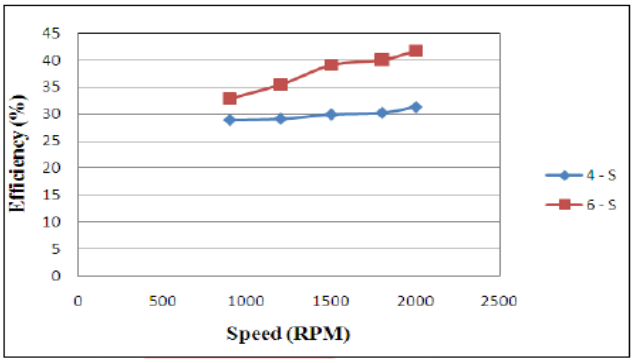

Fig. 1:

From this test we conclude that efficiency of six stroke engine is greater than four stroke engine.

D. Pollution test result:

4 stroke engine	6 stroke engine	% Pollution Redn.
0.92	0.32	65.2

Table 3:

From the pollution test we conclude that pollution caused by six stroke engine is less than the four stroke engine.

VI. GRAPHS FOR SIX STROKE ENGINE

A. Torque-Angle Graph:

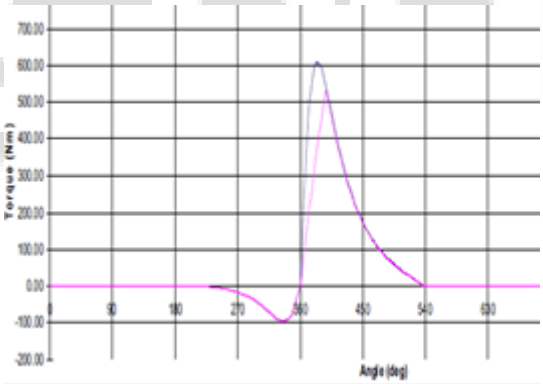

Fig. 2:

From the above graph we can conclude that torque produced by the six stroke engine is comparatively more than the four stroke engine.

B. Comparison of Six Stroke Engine with Four Stroke Engine of P-V Diagram for Otto Cycle:

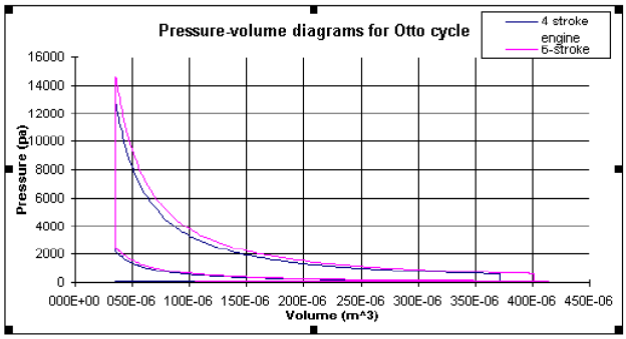

Fig. 3:

From the above graph we observe that P-V diagram of six stroke engine is larger than four stroke engine which means that area covered under the graph by six stroke is more than four stroke and we know that area under p-v diagram is work done ,that means work done by six stroke is larger than the four stroke.

VII. ADVANTAGES OF SIX STROKE ENGINE

- Water itself being good cooling agent therefore no need of extra cooling system.
- The expansion stroke in six strokes is greater than four strokes and more work output is extracted from the expansion stroke.
- Increased torque.
- Efficiency is also increased.
- Reduction of exhaust emissions due to less fuel being consumed.
- Reduction in fuel consumption.
- The change in volume during the compression stroke is slightly higher than four stroke engine
- Longer service intervals are possible due to lower operating temperatures.

VIII. CONCLUSION

This engine would definitely help in the betterment of world economy as it helps in reduction of pollution and supports the advancement of automobile industry as it focuses on fuel efficiency which has become a prime objective in today's scenario. It is commercially obvious that there is a big market for automobile, heavy goods, construction-site and farm vehicles. There is a need of great efficiency engines. The six-stroke engine is one of the alternate, that today we can have. Reducing fuel consumption and pollution without any effect on performance will reassessed the concept of automobile. At present there is no wonder solution for the replacement of the internal combustion engine. Only improvements of the current technology have been done within reasonable time and financial limits. The six-stroke engine fits perfectly into this picture.

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