Six Stroke Engine

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Abstract
The increasing demands for low emissions and low fuel consumption in modern combustion engines requires improved methods for combustion process. The Beare Head is a new type of six-stroke engine head design known as the "Beare Head" after its designer, Malcolm Beare. The Beare Head uses a piston and ports very much like a two stroke engine to replace the overhead valve system that is found in four stroke engines today. The four-stroke block, piston and crankshaft remain unaltered. This combination of two stroke and four-stroke technology has given the technology its name the "six stroke engine". Six Stroke engine, the name itself indicates a cycle of six strokes out of which two are useful power strokes. According to its mechanical design, the six-stroke engine with external and internal combustion and double flow is similar to the actual internal reciprocating combustion engine. However, it differentiates itself entirely, due to its thermodynamic cycle and a modified cylinder head with two supplementary chambers: combustion and an air heating chamber, both independent from the cylinder. In this the cylinder and the combustion chamber are separated which gives more freedom for design analysis. Several advantages result from this, one very important being the increase in thermal efficiency. It consists of two cycles of operations namely external combustion cycle and internal combustion cycle, each cycle having four events. In addition to the two valves in the four stroke engine two more valves are incorporated which are operated by a piston arrangement. The Six Stroke is thermodynamically more efficient because the change in volume of the power stroke is greater than the intake stroke and the compression stroke. The main advantages of six stroke engine includes reduction in fuel consumption by 40%, two power strokes in the six stroke cycle, dramatic reduction in pollution, adaptability to multi fuel operation.Six stroke engine's adoption by the automobile industry would have a tremendous impact on the environment and world economy**.**

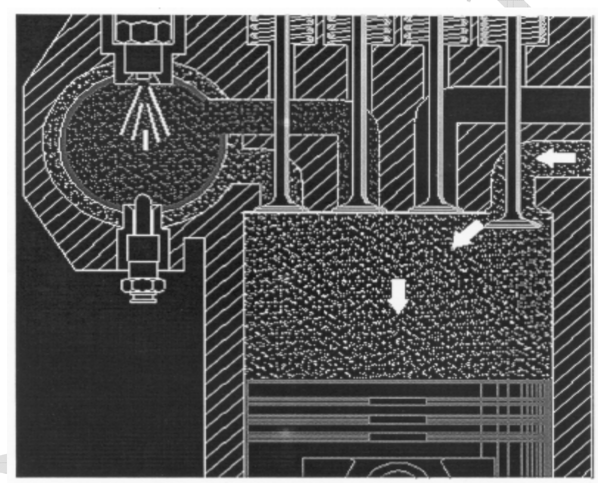
Keywords: Six Stroke engine, combustion engines, Objective and Subjective Methods.

Introduction
The majority of the actual internal combustion engines, operating on different cycles have one common feature, combustion occurring in the cylinder after each compression, resulting in gas expansion that acts directly on the piston (work) and limited to 180 degrees of crankshaft angel.According to its mechanical design, the six-stroke engine with external and internal combustion and double flow is similar to the actual internal reciprocating combustion engine. However, it differentiates itself entirely, due to its thermodynamic cycle and a modified cylinder head with two supplementary chambers: Combustion, does not occur within the cylinder but in the supplementary combustion chamber, does not act immediately on the piston, and it's duration is independent from the 180 degrees of crankshaft rotation that occurs during the expansion of the combustion gases (work).The combustion chamber is totally enclosed within the air-heating chamber. By heat exchange through the glowing combustion chamber walls, air pressure in the heating chamber increases and generate power for an a supplementary work stroke. Several advantages result from this, one very important being the increase in thermal efficiency. IN the contemporary internal combustion engine, the necessary cooling of the combustion chamber walls generate important calorific losses.

Analysis of six stroke engine

Six-stroke engine is mainly due to the radical hybridization of two- and four-stroke technology. The six-stroke engine is supplemented with two chambers, which allow parallel function and results a full eight-event cycle: two four-event-each cycles, an external combustion cycle and an internal combustion cycle. In the internal combustion there is direct contact between air and the working fluid, whereas there is no direct contact between air and the working fluid in the external combustion process. Those events that affect the motion of the crankshaft are called dynamic events and those, which do not effect are called static events.

VIEW OF A SIX STROKE ENGINE

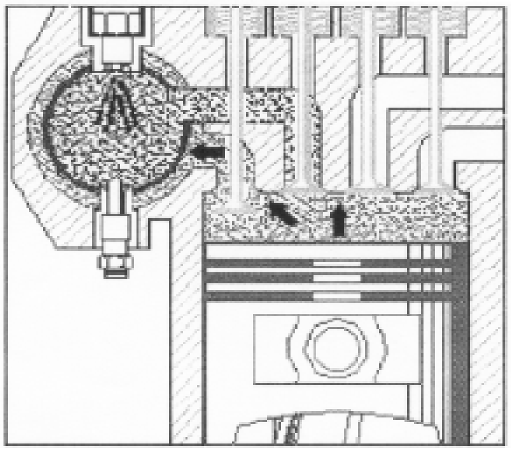


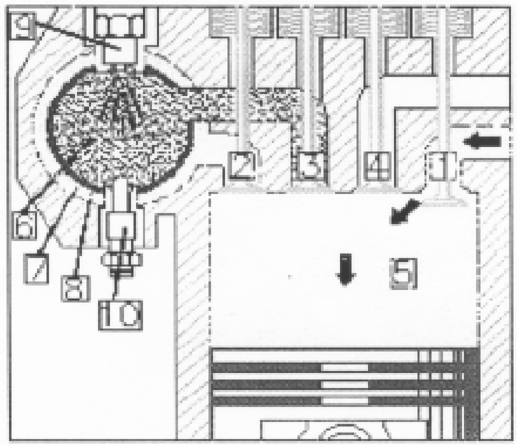
ANALYSIS OF EVENTS

Event 1: Pure air intake in the cylinder (dynamic event)

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. uel injector.
10. Heater plug.

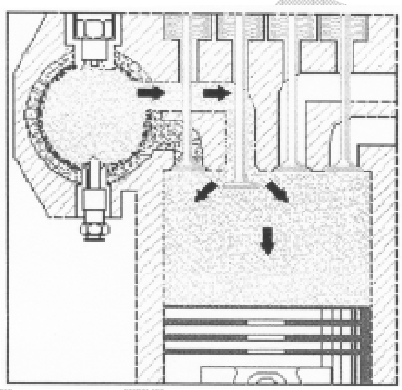
Event 2: Pure air compression in the heating chamber.



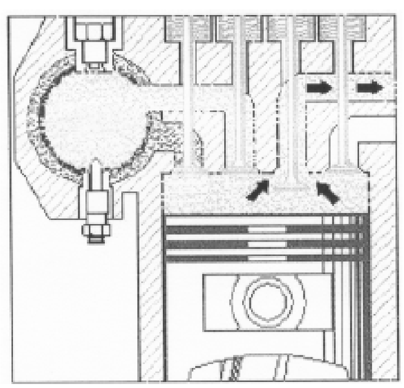


Events 3: fuel injection and combustion in closed combustion chamber, without direct action on the crankshaft (static event).

Events 4: Combustion gases expanding in the cylinder, work (dynamic event).

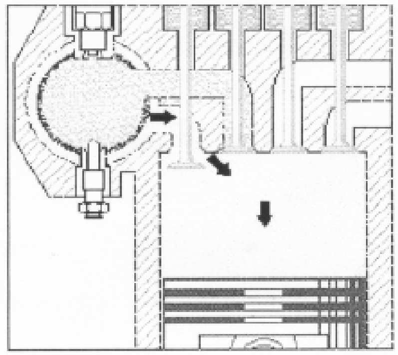


Events 5: Combustion gases exhaust (dynamic event).

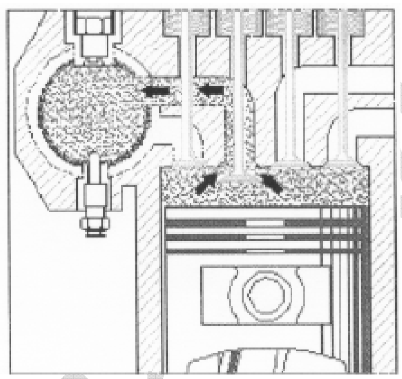


Event 6: Keeping pure air pressure in closed chamber where a maximum heat exchange occurs with the combustion chambers walls, without direct action on the crankshaft (static event).

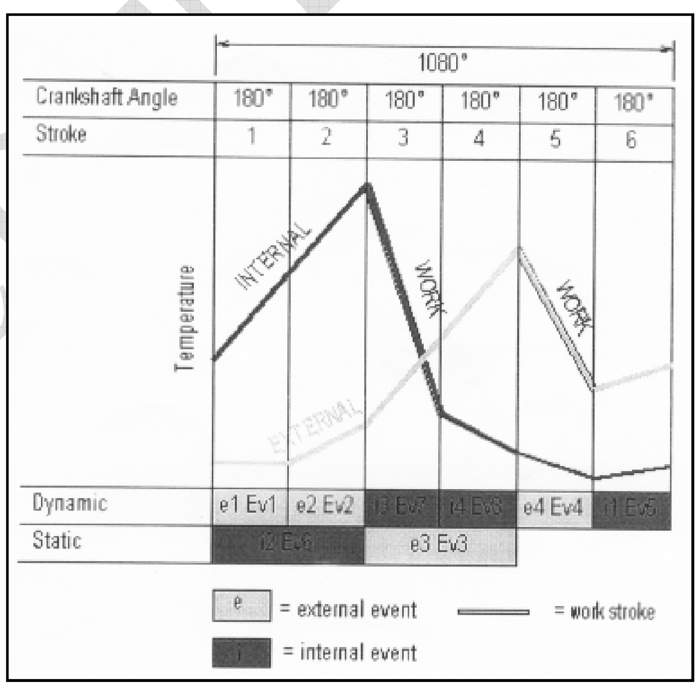
Event 7: Expansion of the Super heat air in the cylinder work (dynamic Event).



Event 8: Re-compressions of pure heated air in the combustion chamber
(Dynamic event).



SIX-STROKE ENGINE CYCLE DIAGRAM



External combustion cycle: (divided in 4 events):

No direct contact between the air and the heating source.

e1. (Event 1) Pure air intake in the cylinder (dynamic event).

e2. (Event 2) Compression of pure air in the heating chamber (dynamic event).

e3. (Event 3) Keeping pure air pressure in closed chamber where a maximum heat exchange occurs with the combustion chambers walls, without direct action on the crankshaft (static event).

e4. (Event 4) Expansion of the super heated air in the cylinder, work (dynamic event).

Internal combustion cycle: (divided in 4 events)

Direct contact between the air and the heating source.

I1. (Event 5) Re-compression of pure heated air in the combustion chamber (dynamic event)

I2. (Event 6) Fuel injection and combustion n closed combustion chamber, without direct action on the crankshaft (static event).

I3. (Event 7) Combustion gases expanding in the cylinder, work (dynamic event).

I4. (Event 8) Combustion gases exhaust (dynamic event).

CONSTRUCTIONAL DETAILS

The sketches shows the cylinder head equipped with both chambers and four valves of which two are conventional (intake and exhaust). The two others are made of heavy-duty heat-resisting material. During the combustion and the air heating processes, the valves could open under the pressure within the chambers. To avoid this, a piston is installed on both valve shafts which compensate this pressure. 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. Their small thickness allows heat exchange with the air-heating chamber, which is surrounding the combustion chamber. The air-heating chamber is isolated from the cylinder head to reduce thermal loss. The combustion and air-heating chambers have different compression ratio. The compression ratio is high for the heating chamber, which operates on an external cycle and is supplied solely with pure air. On the other hand, the compression ratio is low for the combustion chamber because of effectively increased volumen, which operates on internal combustion cycle.The combustion of all injected fuel is insured, first, by the supply of preheated pure air in the combustion chamber, then, by the glowing walls of the chamber, which acts as multiple spark plugs. In order to facilitate cold starts, the combustion chamber is fitted with a heater plug (glow plug). In contrast to a diesel engine, which requires a heavy construction, this multi-fuel engine, which can also use diesel fuel, may be built in a much lighter fashion than that of a gas engine, especially in the case of all moving parts.As well as regulating the intake and exhaust strokes, the valves of the heating and the combustion chambers allow significantly additional adjustments for improving efficiency and reducing noise.

ADVANTAGES OF SIX STROKE OVER FOUR STROKE ENGINES

The six stroke is thermodynamically more efficient because the change in volume of the power stroke is greater than the intake stroke, the compression stroke and the Six stroke engine is fundamentally superior to the four stroke because the head is no longer parasitic but is a net contributor to – and an integral part of – the power generation within exhaust stroke. The compression ratios can be increased because of the absent of hot spots and the rate of change in volume during the critical combustion period is less than in a Four stroke. The absence of valves within the combustion chamber allows considerable design freedom.

Main advantages of the six-stroke engine:

Reduction in fuel consumption by at least 40%:

An operating efficiency of approximately 50%, hence the large reduction in specific consumption. the Operating efficiency of current petrol engine is of the order of 30%. The specific power of the six-stroke engine will not be less than that of a four-stroke petrol engine, the increase in thermal efficiency compensating for the issue due to the two additional strokes.

Two expansions (work) in six strokes:

Since the work cycles occur on two strokes (360^0 out of 1080^0) or 8% more than in a four-stroke engine (180^0 out of 720), the torque is much more even. This lead to very smooth operation at low speed without any significant effects on consumption and the emission of pollutants, the combustion not being affected by the engine speed. These advantages are very important in improving the performance of car in town traffic.

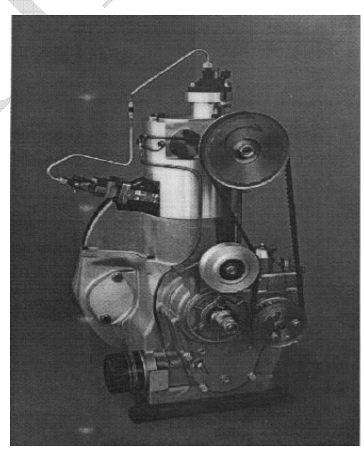
Dramatic reduction in pollution:

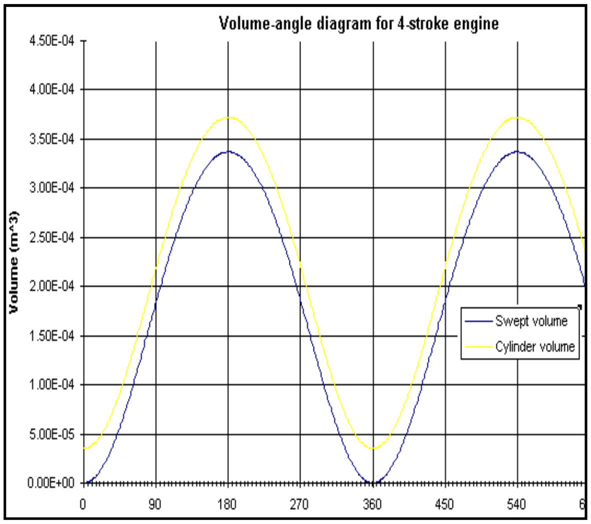
Chemical, noise and thermal pollution are reduced, on the one hand, in proportion to the reduction in specific consumption, and on the other, through the engine's own characteristics which will help to considerably lower HC, CO and NOx emissions. Furthermore, it's ability to run with fuels of vegetable origin and weakly pollutant gases under optimum conditions, gives it qualities which will allow it to match up to the strictest standards.

Multifuel:

Multifuel par excellence, it can use the most varied fuels, of any origin (fossil or vegetable), from diesel to L.P.G. or animal grease. The difference in inflammability or antiknock rating does not present any problem in combustion. It's light, standard petrol engine construction, and the low compression ration of the combustion chamber; do not exclude the use of diesel fuel. Methanol-petrol mixture is also recommended.

Prototype of a six stroke engine





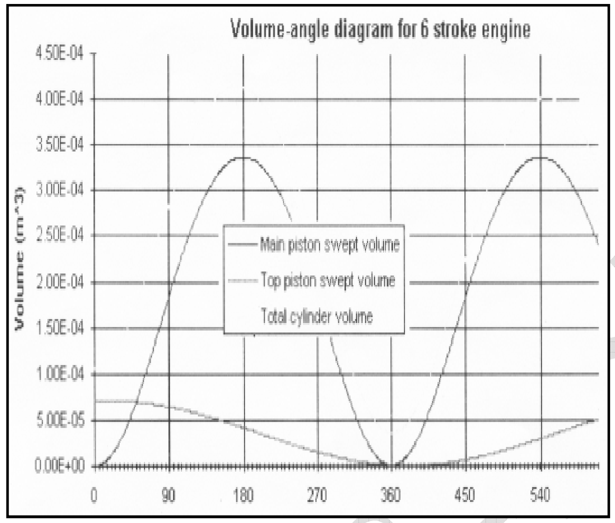
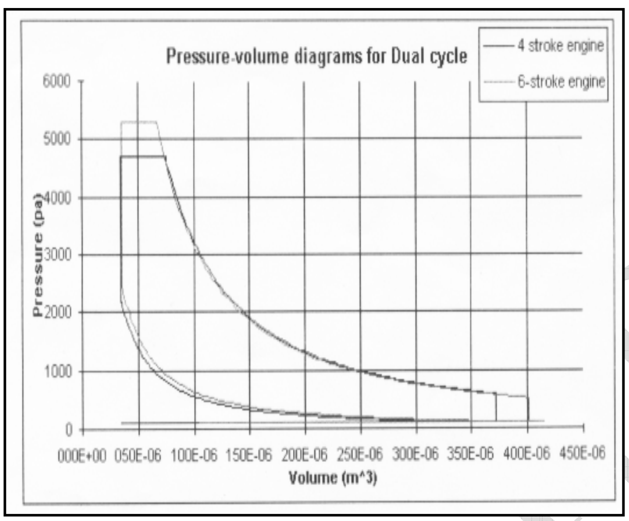


Fig. angle diagram for 4 stroke engine

Fig.Volume angle diagram for 6 stroke engine



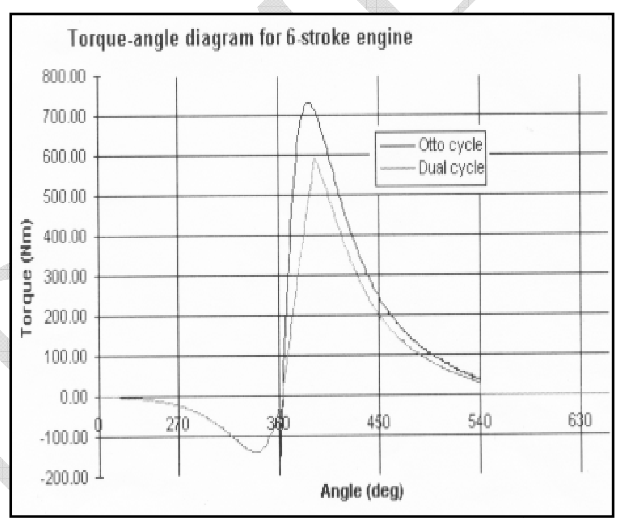


Fig. Pressure-volume diagrams for Dual cycle

Fig. Torque-angle diagram for 6 stroke engine

Conclusion

There is, at this day, no wonder solution for the replacement of the internal combustion engine. Only improvements of the current technology can help it progress within reasonable time and financial limits. The six-stroke engine fits perfectly into this view. It's adoption by the automobile industry would have a tremendous impact on the environment and world economy, assuming up to 40% reduction in fuel consumption and 60% to 90% in polluting emissions, depending on the type of the fuel being used. An allied with the so-responsive pickup and a wide spread of usable power, makes the bike ridiculously easy to ride. You hardly need to use the gearbox, just park it in top gear and ride. Even backing off the throttle in the middle of a turn doesn't require hooking down a gear — just crack it open when you're ready and feel the front wheel start to aviate on you. And hands-on assessment of the six-stroke leads to some inescapable conclusions. The industry trend away from cheaper two-stroke power in favor of costlier but cleaner four-stroke engines in both Europe, Japan and South East Asia makes a concept like the Beare six-stroke, which offers the best of both worlds, project a strong case towards volume manufacture.

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