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SPECULATIVE ANALYSIS FOR DESIGN CONSIDERATIONS IN SIX STROKES INTERNAL COMBUSTION ENGINE

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ABSTRACT

The modern four stroke combustion engine has been wide applied attributable to glorious power to weight magnitude relation and reliableness. However, the foremost drawback of the even most effective trendy four stroke engine is that the production of great amounts of excess energy, dissipated though the cylinder walls of the engine and expelled as waste energy throughout the exhaust stroke of the cycle. the event of a lot of economical six stroke combustion engine for increasing the potency of 4 stroke engine for that the ultimate 2 strokes designed to used of exhaust and convert it into power stroke and at last six stroke operating as exhaust stroke and additionally batter scavenging. a number of basic modifications ar wiped out four stroke engine and created a six stroke engine we are able to increase the brake thermal potency of the engine. additionally the dramatic reduction in pollution and batter scavenging happens.

Key Words: 2-Cylinder 4-Stroke diesel motor, Cam-Shaft , Flywheel.

I. INTRODUCTION

As the time passes, it's believed that the crude oil product and rock oil are not enough and can be expensive. Varied researches area unit occurring for the development of fuel economy of engines. but because the demand and accessibility for gasoline and diesel is somewhat unbalanced and there's a necessity to balance since that's chiefly happened thanks to huge increase in variety of vehicles. If an equivalent state of affairs continues then the state of affairs are additional fatal and gasoline and diesel are additional expensive and restricted. With augmented use and also the depletion of fossil fuels, nowadays additional stress is given on the alternate fuels.

1.1 Objective

- Minimum fuel consumption
- Reduction in pollution
- Better scavenging and more extraction of work per cycle

The term six stroke engine describes 2 completely different approaches within the burning engine, developed since the Nineteen Nineties, to enhance its potency and scale back emissions.

In the initial approach, the engine captures the waste heat from the four stroke Otto cycle or Diesel cycle and uses it to urge a further power and exhaust stroke of the piston within the same cylinder. styles either use steam

or air because the operating fluid for the extra power stroke. moreover as extracting power, the extra stroke cools the engine and removes the requirement for a cooling system creating the engine lighter and giving four-hundredth magnified potency over the traditional Otto or Diesel Cycle. The pistons during this six stroke engine go up and down sixfold for every injection of fuel. These six stroke engines have a pair of power strokes: one by fuel, one by steam or air. The presently notable six stroke engine styles during this category square measure the Crower's six stroke engine, made-up by Bruce Crower of the U.S.A; the Bajulaz engine by the Bajulaz S an organization, of Schweiz; and therefore the Velozeta‟s Six-stroke engine engineered by the school of Engineering, at Trivandrum in India.

The second approach to the six stroke engine uses a second opposed piston in every cylinder that moves at 0.5 the diurnal rate of the most piston, therefore giving six piston movements per cycle. Functionally, the second piston replaces the valve mechanism of a standard engine and conjointly it will increase the compression magnitude relation. The presently notable six stroke engine styles during this category embody 2 styles developed independently: the Beare Head engine, made-up by Australian farmer Malcolm Beare, and therefore the German Charge pump, made-up by Helmut Kottmann.

Engineer prophet mythical creature was the primary six stroke engine developer within the world. mythical creature had found this engine in 1883 and this engine primarily used for electrical power generation. solely 2 glorious example of a mythical creature six stroke engine these days. One is within the Anson engine deposit. the opposite was in-built 1885 and for a few years was within the Birmingham deposit of Science and technology.

The Bajulaz Six Stroke Engine was made-up in 1989 by the Bajulaz S an organization, primarily based in Geneva, Switzerland. The Bajulaz six stroke engine is analogous to an everyday combustion engine in style. There was a modification to the plate, with 2 supplementary mounted capability chambers, a combustion chamber ANd an air preheating chamber higher than every cylinder. The combustion chamber receives a charge of heated air from the cylinder; the injection of fuel begins, at an equivalent time it burns that will increase the thermal potency compared to a burn within the cylinder. The high achieved is then free into the cylinder

to work the ability or growth stroke. meantime a second chamber that blankets the combustion chamber has its air content heated to a high degree by heat passing through the cylinder wall. This heated and controlled air is then wont to power a further stroke of the piston. the benefits of the engine embody reduction in fuel consumption by four-hundredth, multi-fuel usage capability, and a dramatic reduction in pollution.

Crower six stroke engine is made-up by Bruce crower of CA in USA within the year 2004. Bruce Crower is truly a auto mechanic along with his own workshop. In his six-stroke engine, power is obtained within the third and sixth strokes. initial four strokes of this engine square measure the same as a standard four stroke engine and power is delivered within the third stroke. simply before the fifth stroke, water is injected directly into the heated cylinder via the reborn diesel engine's fuel contraption pump. The injected water absorbs the warmth created within the cylinder and converts into superheated steam, that causes the water to expand to 1600 times its volume and forces the piston down for a further stroke i.e. the number stroke. The phase transition from liquid to steam removes the surplus heat of the engine. As a considerable portion of engine heat currently leaves the cylinder within the variety of steam, no cooling system radiator is needed. Energy that's dissipated in typical arrangements by the radiation cooling system has been reborn into extra power strokes. In Crower's model, the

water for the steam cycle is consumed at a rate more or less adequate to that of the fuel, however in production models, the steam are going to be recaptured in an exceedingly condenser for re-use.

Malcolm Beare forty seven year recent Australian wheat farmer is that the creator of this six stroke engine. really the name six stroke engines was introduced by Malcolm Beare. Beare created AN innovative hybrid engine, combining two-strokes within the prime finish with a four-stroke higher than the center portion. thus by adding this four and 2 equals six, he derived the name six stroke engines. Below the plate seal, everything is typical, in his style. thus one main advantage is that the Beare construct will be transplanted to existing engines with none redesigning or retooling the lowest finish and cylinder. however the plate and its poppet valve valves get thrown away during this style. to exchange the shaft and valves, Beare used a short-stroke higher shaft complete with piston, that is driven at 0.5 engine speed through the chain drive from the engine. This piston moves against the most piston within the cylinder and if the lowest piston comes fourfold upwards, higher piston can return down doubly. The compression of charge takes place in between these 2 pistons. a lot of higher compression ratios will be obtained during this engine. Malcolm used on his initial six-stroke, supported a Honda XL125 farm bike. Malcolm Beare claims his engine is thirty fifth additional economical at low revs/throttle openings than a similar typical engine and thirteen less thirsty at high rpm/full throttle.

In Charge pump engine, similar in style to the Beare head, a „piston charger" replaces the valve system. The piston charger charges the most cylinder and at the same time regulates the water and therefore the outlet aperture resulting in no loss of air and fuel within the exhaust. within the main cylinder, combustion takes place each flip as in an exceedingly two-stroke engine and lubrication as in an exceedingly ICE. fuel injection system will occur within the piston charger, within the gas transfer channel or within the combustion chamber. it's conjointly attainable to charge 2 operating cylinders with one piston charger. the mix of compact style for the combustion chamber along with no loss of air and fuel is claimed to relinquish the engine additional torsion, additional power and higher fuel consumption. The good thing about less moving elements and style is claimed to guide to lower producing prices. smart for hybrid technology and stationary engines. The engine is claimed to be suited to various fuels since there's no corrosion or deposits left on valves. The six strokes are: aspiration, pre-compression, gas transfer, compression, ignition and ejection.

Mechanical Engineering students of the school of Engineering in Trivandrum, within the year 2006 created this six stroke engine as a region of their B.Tech project. when the completion of the course they fashioned the corporate Velozeta with the assistance of state and central government. they need got the patent of this engine conjointly. In Velozeta"s six stroke engine, a four-stroke Honda engine was by experimentation altered to make the six stroke engine. the primary four strokes of this engine square measure similar to a standard four stroke engine. the extra 2 strokes square measure for higher scavenging and cooling of the engine that is provided by a secondary air induction system.

1.2 Previous Work

In six stroke engine, there are additional two strokes, namely another power and exhaust strokes. The engine works through harnessing wasted heat energy created by the fuel combustion. After the combustion stage water is injected into the superheated cylinder. The water explodes into steam and force the piston down. It in turn helps to cool the engine. That resulted in normal levels of power but using much less fuel. It also has the

advantage of not requiring an external cooling system. In order to achieve these benefits, major modifications of conventional internal combustion engine must be done.

1.3 Limitation of Sixstroke Internak Combustion Engine

- Engine size increases due to number of cylinder and additional components.
- Higher manufacturing cost of six stroke engine.

1.4 Concept of Six Stroke Internal Combustion Engine

The 6 stroke ICE is advancement over the existing 4 stroke ICE which employs the same principle as that of the 4 stroke ICE. The 5th stroke or the second power stroke uses the heat evolved in the exhaust stroke (directly or indirectly) as heat required for the sudden expansion of the secondary fuel (air or water) which pushes the piston downward for the 2nd power stroke thereby rotating the crankshaft for another half cycle. As heat evolved in the 4th stroke is not wasted, the requirement for a cooling system is eliminated.

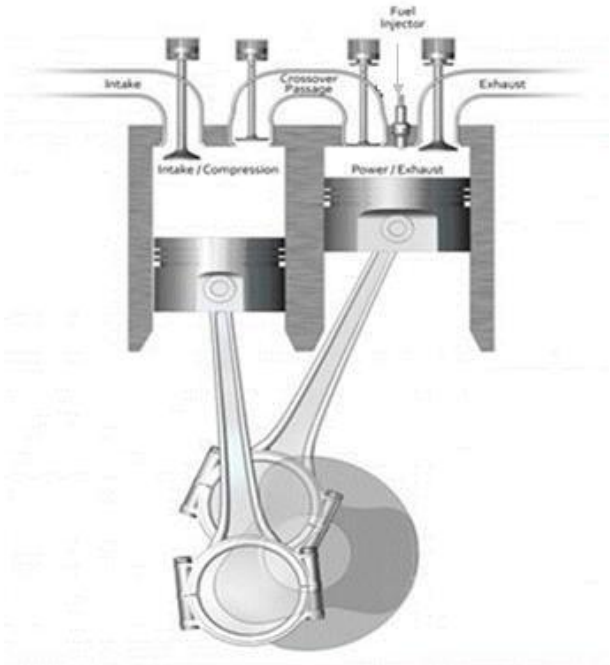

Figure 1 Concept of Six Stroke Engine

Here fuel is injected once in every 3 complete cycles of the crankshaft which is any time better than a 4 stroke ICE where fuel is injected once in 2 complete cycles of the crankshaft. It should be noted that efficiency of the 6 stroke ICE is more than the existing 4 stroke ICE. Major type of secondary fuels used in the 5th stroke is air and water. Many types of 6-ICE have now been designed on these 2 fuels of which few important types will be discussed.

II. ENGINE PARTS MODIFICATION

2.1 Crankshaft To Camshaft Speed Ratio

The original angular speed of the camshaft is one-half that of the crankshaft, such that the camshaft rotates once for every two revolutions (or four strokes) of the crankshaft. The crankshaft pulley of the unmodified (4-stroke

engine) engine has a 21 tooth and camshaft pulley of the engine has a 42 tooth. In conventional four stroke engine ,the crankshaft must rotate720° while the camshaft rotates 360° to complete one cycle. For six-stroke engine, the crank shaft must rotate 1080°to rotate the cam shaft 360° and to complete one cycle. Hence their corresponding speed ratio is 3:1. In modified engine a camshaft pulley has a 42 tooth which is same as that was in unmodified (4-stroke engine) engine and crankshaft pulley has a 14 tooth which is 1/3 of the camshaft pulley because the rotation ratio of crankshaft to camshaft is 3:1 in six stroke engine. So it is necessary to keep camshaft pulley three time bigger than crank shaft pulley.

Figure 2 Timing Pulley For Six Stroke Engine

2.2 Modification in Inlet and Exhaust Manifold

In given 4 stroke engine there is common inlet manifold through which required quantity of fresh charge from atmospheric air is sucked due to movement of piston and vaccum creation and mixed with the fuel for proper combustion.

Figure 3 Inlet and Exhaust Manifold of Four Stroke Engine

As shown in figure 4 the common inlet manifold of four-stroke engine parted by welding a plate between the common inlet manifold. In six-stroke engine fuel is supplied in only 1st cylinder and not in second cylinder but exhaust of first cylinder is transferred to second cylinder. For carrying out the exhaust gases of second cylinder, inlet manifold of second cylinder is used for this purpose.

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The plate welded between the inlet manifold is of aluminum. Because manifold is made of aluminum. The main benefit of this manifold is exhaust gases come out at high temperature so it will preheat the inlet air so increase the combustion rate.

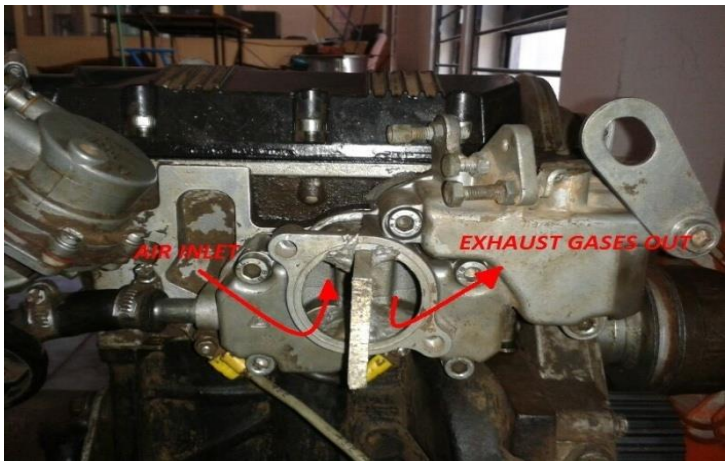

Figure 4 Modified Inlet and Exhaust Manifold of Six Stroke Engine

Fig 4 shows the exhaust manifold of four stroke engine in which exhaust of both cylinder is carried out through separate manifold and exhausted to atmosphere by single exhauster.

In six stroke engine exhaust of first cylinder is get used to run the second cylinder, therefore to transfer exhaust of first cylinder to second cylinder exhaust manifold is sealed using packing at the connection where two exhaust manifold are meet so that exhaust gas is transferred to the second cylinder instead of exhauster.

2.3 Design Of Cam Lobes

The diameter of camshaft (D) is taken empirically as

D = 0.16 × cylinder bore + 12.7 mm

= 0.16 × 75 + 12.7

= 35.1 say 36 mm

The base circle diameter is about 3 mm greater than the camshaft diameter.

Base circle diameter = 36 + 3 = 36 say 40 mm

The width of cam is taken equal to the width of roller, i.e. 14 mm

The width of cam (W) is also taken empirically as

W= 0.09 × cylinder bore + 6 mm

= 0.09 × 75 + 6

= 18.6 mm

2.3.1 Cam Profile For First Cyliner Inlet And Exhaust Valve

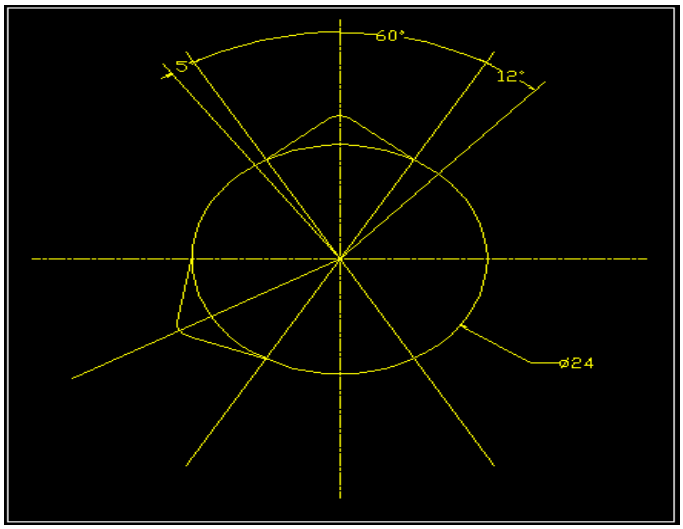

Figure 5 Cam Profile for First Cylinder Inlet Valve

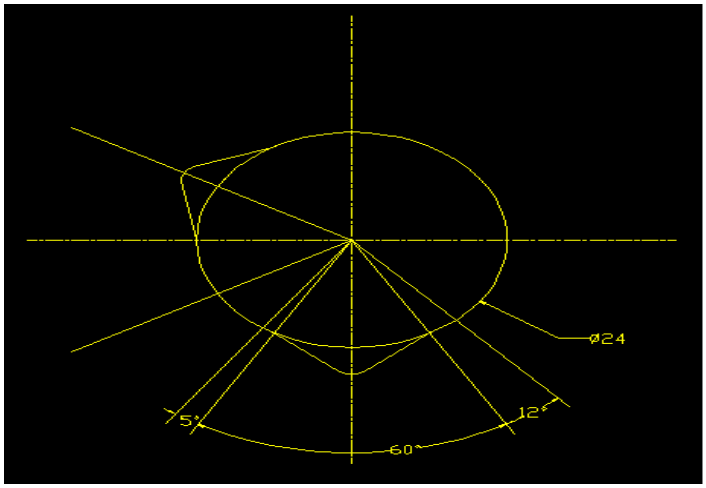

Figure 6 Cam Profile for First Cylinder Exhaust Valve

III. CONCLUSION

The six stroke engine modification promises dramatic reduction in fuel consumption of an internal combustion engine. The fuel efficiency of the engine can be increased and also the valve timing can be effectively arranged to extract more work per cycle. The brake thermal efficiency of four stroke two cylinder diesel engine can increases by modified its some component and convert into six stroke engine. Better scavenging is possible because exhaust of first cylinder exhaust is become a inlet of second cylinder during the fifth stroke and its work as second power stroke the exhaust during the sixth stroke.

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