iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 6 **Issue:** IV **Month of publication:** April 2018

DOI: http://doi.org/10.22214/ijraset.2018.4715

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 6 Issue IV, April 2018- Available at www.ijraset.com

Analysis to Improve the Engine Performance using Magnetic Field and Swirl Vane.

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Abstract: ***This paper deals with fuel ionization by using magnetic field and swirling by using swirl vane which will ensure complete combustion of air fuel mixture. During combustion of air fuel mixture, some of the fuel does not participate in the combustion process, which will results in Un burnt gases to exhaust and loss of fuel. To improve combustion efficiency of internal combustion engines, we are going to ionize the fuel by using magnetic field. The magnetic field created by using a magnet, around the flow of fuel line. i.e. in front of combustion chamber. The ionized fuel will pass through swirl vane, which will increase the swirl number of air fuel mixture. Due to swirling action of air fuel mixture we can ensure complete mixing and the mixture completely burns in combustion chamber. The swirl vane is placed in mixture flow tube of IC engine.***
Keywords: swirling action, swirl vane and combustion efficiency of engine.

I. INTRODUCTION

An engine is a device which converts the fuel energy in to mechanical energy. The combustion of fuel takes place in the combustion chamber, due to fuel combustion high pressure will produce thrust on the piston surface, the piston and connecting rod, crank shaft arrangement is used to convert pressure energy in to mechanical energy.

Most important function of CI engine combustion chamber is to provide proper mixing of fuel and air in short possible time. During combustion of air fuel mixture, some of the fuel does not participate in the combustion process, which will results in Un burnt gases to exhaust and loss of fuel. For this purpose an organized air movement called air swirl is to be produced to produce high relative velocity between the fuel droplets and air. Swirl is what is taking place when the intake charge exits the intake valve and enters the combustion chamber. As the air enters the combustion chamber and the piston travels down in the bore, it causes a spiraling effect. The air in the spiraling effect actually travels around the bore such as water goes around in a flushing toilet. This effect is used in helping to fill the cylinder. It is swirl that controls the engine's output and rpm.

The molecules of any gas or liquid carry + ve / - ve electric charges. These molecules get attracted to each other and form 'clusters'. In such condition, when the fuel is mixed with air, all the molecules of the fuel may not combine with the oxygen molecules in the air, in order burn and give out heat energy. Some of the fuel molecules burn and the rest escape in the atmosphere as un-burnt gases. This leads to poor fuel efficiency and pollution of the atmosphere.

In the presence of the magnetic field created by the permanent magnets', the fuel molecules are oriented in a particular direction and the molecular clusters are opened out (as shown in the diagram above). This is called 'ionization'. Ionized fuel molecules combine with oxygen molecules in the air quickly and burn effectively. This more effective burning increases the flame temperature and higher heat energy, leading to fuel saving and reduction of air pollution.

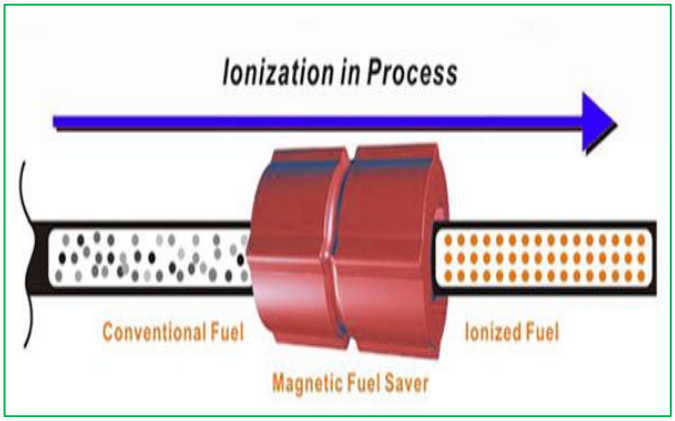

Fig1: Fuel ionization process

Shape	Rectangular
Gauss value	6000 gauss
Type	NbFe
Curie temperature	250^0c to 300^0c

Table1: permanent magnet specifications.

In this we used two magnets which are attracting each other, in between the magnets the fuel pipe will be there. The magnetic lines will pass through the fuel, which will ionize the fuel. The ionized fuel will combust in combustion chamber, which results in fuel economy.

Swirling is a rotational flow of charge within the cylinder about its axis. Swirling can be generated by constructing the intake system to give tangential component to the intake flow as it enters the cylinder. This is done by shaping and contouring the intake manifold, valve ports, even piston face.

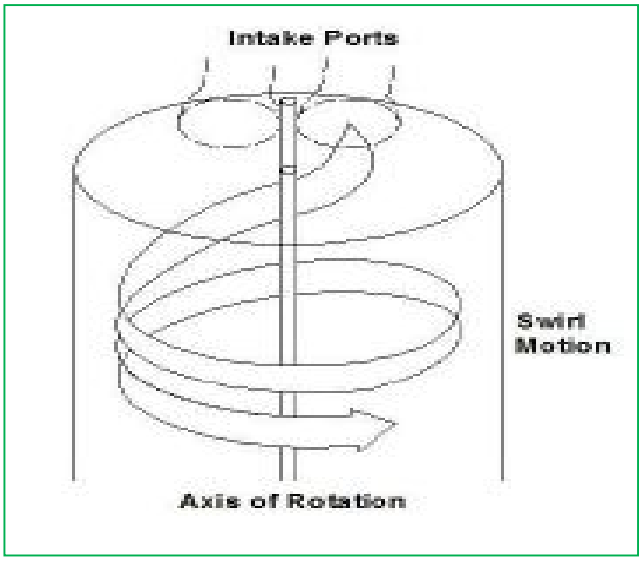

Fig 2:swirl process in engine.

Swirling greatly enhances the mixing of air fuel to give a homogenous mixture in very short time available for this in modern high speed engines. It is also a main mechanism for spreading of the flame front during the combustion process.

The swirl number of a straight-vane swirl assembly can be approximated as shown in the equation below.

$$\frac{2}{3} X \frac{1-(\frac{d_h}{d_o})^3}{1-(\frac{d_h}{d_o})^2} X \tan(\theta) = S$$

Here,

d_h is the hub diameter of the swirler.

d_o is the outer diameter of the swirler.

□□is the angle of swirl vane.

The swirl number is thus found to depend primarily on □, the swirl vane angle.The values are

dh =22 mm, do=5mm and $\theta = 45^0$

Now, swirl number S = 0.7

CATIA V5, developed by Dassault Systems, France, is a completely re-engineered, next-generation family of CAD/CAM/CAE software solutions for Product Lifecycle Management. Through its exceptionally easy-to-use and state-of-the-art user interface, CATIA V5 delivers innovative technologies for maximum productivity and creativity, from the inception concept to the final product. CATIA V5 reduces the learning curve, as it allows the flexibility of using feature-based and parametric designs.

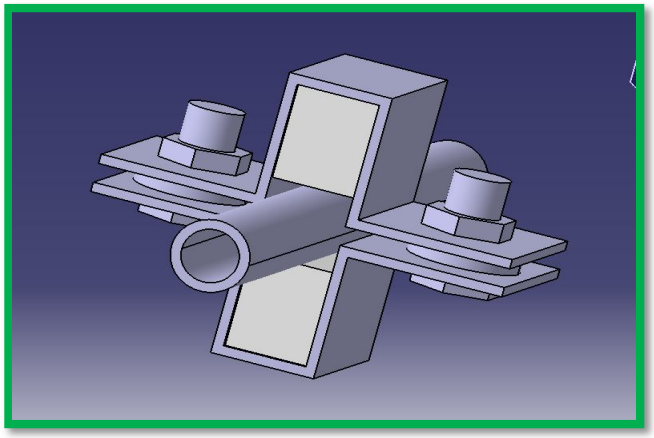

Fig 3:CATIA model of magnetic holder

Magnetic holder is assembly product, which is created in CATIA using sketch and part modules. And individual parts are imported into assembly to join it. This assembly model is used to create the prototype model.

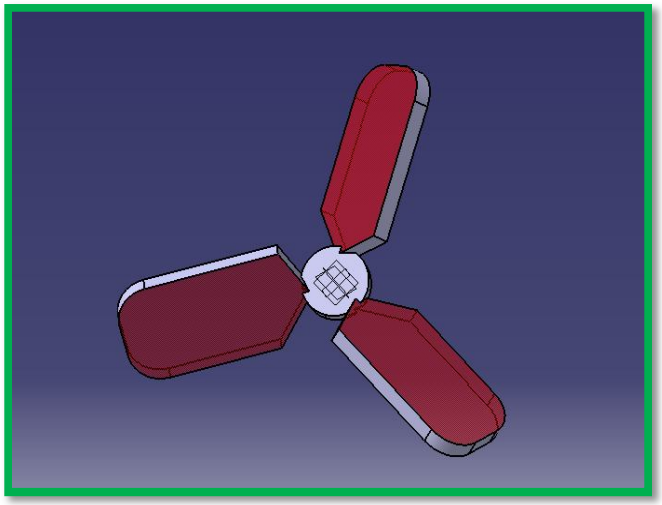

Fig 4:CATIA model of swirl vane

Swirl vane model is created using required dimensions. Here hub diameter is provided with 5mm . Each vane is rotated with 45^0 angle. Using PAD and transformation based features 3d model of swirl vane is created. Finally model is fabricated with maintaining the dimensions as shown as below.

Outer Diameter of swirl vane	22mm
Hub diameter of swirl vane	5mm
Number of vanes	3
Angle of vane	45^0
Thickness of vane	1mm
Length of vane	8mm
material	galvanized iron

Table2: swirl vane specifications.

Fig 5:fabricated model of swirl vane

The primary task of the development engineer is to reduce the capital and running cost of the engine. This involves trail of various design concepts. The parameters are so enormous and different in nature that it is almost physically impossible to take care of all of them during the design of the engine. Therefore, it is necessary to conduct a test on the engine and determine the measures which should be taken to improve the engine performance. The nature and the type of the test to be conducted will depend up on great number of factors such as, the degrees of development of the particular design, the accuracy required, the fund available, the nature of the manufacturing company etc. The testing of the engine is necessary to verify the performance of the engine as per the specification of the manufacturer. We used the four stroke petrol engine to conduct the performance test.

Type of engine	four stroke petrol engine
No of cylinders	one
Maker	Hero Honda
Capacity	100 CC
No of gears	4

Table3: engine specifications.

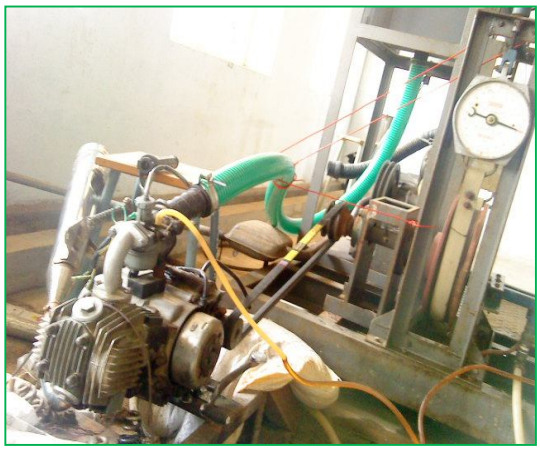

Fig 6: experimental setup for testing.

First, start the engine and give constant acceleration, i.e. maintain constant speed during the test. 2. Note down the head of water in the manometer.3.Note down the speed of drum in terms of rmp.4.Find out the time taken to consume the 10ml fuel.5.Apply the loads 5, 6, 7 and repeate the procedure .and note down the readings.

1) *Speed Measurement:*-Speed of the drum is measured by using speed sensor. The sensor reads the speed and display on the digital meter.
2) *Fuel Consumption:*- Fuel consumption is measured in terms of time. Time taken to consume the 10 ml petrol.
3) *Head Of Water Measurement:*-Head of water is measured by using the manometer which is connected to the orifice. It is measured in terms of mm.
4) *Load:*-Load is applied on the drum by using brake drum dynamometer. The applied load is tabulated every time. It is measured in terms of kg.

All the reading are taken at different load conditions and tabulated in the tabular form. The performance test conducted on engine with swirl vane magnet, but the procedure is same.

a) *Performance Test On Engine With Swirl Vane:* In this experiment we placed the swirl vane in the inlet manifold and the performance test was done. The swirl vane consists of three vanes and outer diameter is 22 mm. the figure shows the swirl vane.

Fig 7: Swirl vane

b) *Performance Test On Engine With Magnet:* In this experiment, we placed the magnet around the fuel line by using magnetic holder. Due to installing magnetic holder the consumption will decrease. The figure shows the magnetic folder on the fuel line.

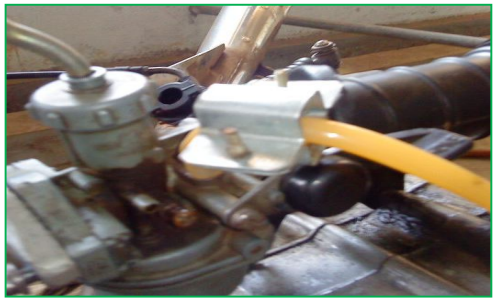

Fig 8: Magnetic fuel saver on fuel line

c) *Performance Test On Engine With Swirl Vane And Magnetic Fuel Saver*: Both magnet and swirl vane in attached to the engine and performance test is conducted to find the effectiveness of the engine. By using both magnet and swirl vane the performance of engine will increase.

Fig 9: Engine with vane and magnet

B.P. = (T×2ΠN/60×1000) KW.
= (5*9.81*2*3.1428*1094)/(60000}
= 0.842 KW.

Ma = 4.78(Hw/1.29) $^{(1/2)}$
= 4.78(6.0/1.29) $^{(1/2)}$
= 10.308. Kg/hr

M_f = (10*0.75*60*60)/(t*1000)
= (10*0.75*60*60)/(38*1000)
= 0.7105 kg/hr

A/F = (Ma/ M_f)
= (10.308/0.7105)
= 14.5

B.S.F.C = (Mf/B.P)
= (0.7105/0.842)
=0.8432 kg/kwhr

Efficiency = (B.P/F.P)
= (0.842/8.68)
= 9.7%

II. CONCLUSION

The swirl vane and the magnet effects the fuel combustion in the internal combustion engine. After conducting the experiments we can conclude that Fuel consumption is decreases with swirl vane magnetic arrangement as compared without swirl vane and magnetic. Air and fuel ration is increased by nearly 12% with both arrangement. Brake specific fuel consumption decreases with 6% by using two arrangement. Finally thermal efficiency is increased by 9.3%. So the magnets and swirl vane can used to improve the performance of internal combustion engines. It also used where the combustion of gases and fuel takes place.

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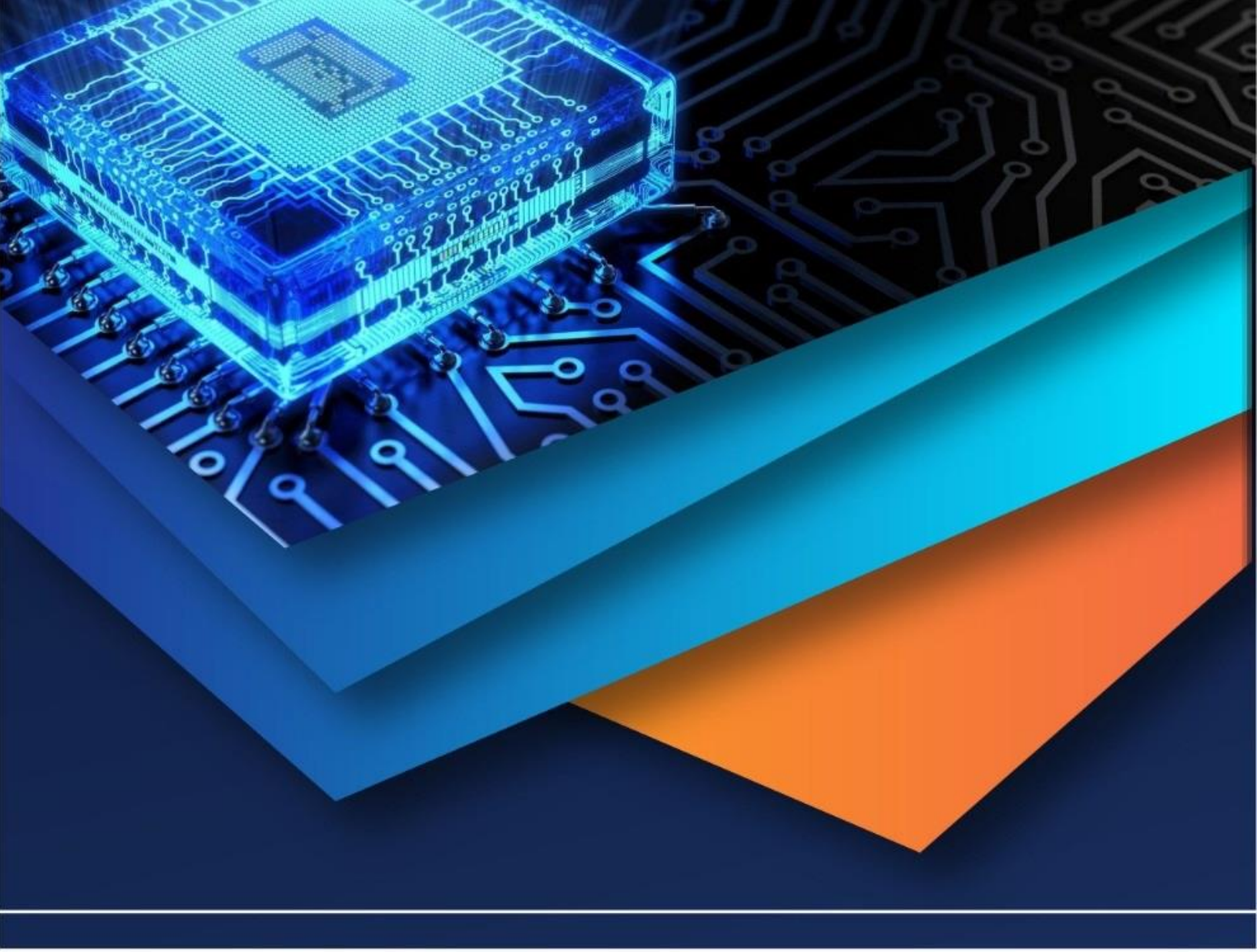

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