R.Naveen et. al. International Journal of Recent Research Aspects ISSN: 2349-7688, Vol. 4, Issue 4, Dec 2017, pp. 207-211

Increasing the Efficiency of IC Engine By Using Air Pre Heater

R.Naveen [1], S. Kapilnath [2], S.Pradheep [3], N. Madhankumar [4], Saravana Kumar.K[5]

[1,2,3,4] UG Scholar, [5]Assistant Prof

Department of Mechanical, Sengunthar College of Engineering

Abstract- **The increasingly worldwide problem regarding rapid economy development and a relative shortage of energy, the internal combustion engine exhaust waste heat and environmental pollution has been more emphasized heavily recently. Our foremost aim of selecting this research is to use efficiency increasing. It is also good with regard to economic considerations and engine efficiency. The concept of increasing the fuel efficiency of a petrol engine in this research is to preheat the intake air which is flowing through the carburetor .This type of system has not been introduced in two wheelers; this may be very useful to two wheelers without any complication and maintenance. But the pre-heater design depends on the exhaust pipe fitted to the particular two-wheeler. The design is simple, cheap and does not give any trouble to the engine.**

I. INTRODUCTION

This research project is the beginning of an investigation into the improvements in fuel combustion efficiency, through applying a preheating treatment to the inlet air. The concept of increasing the fuel efficiency of petrol engine in this project, is to pre-heat the intakes air which is flowing through the carburetor. The humidity in the atmospheric air affects the petrol vaporization in the carburetor. Therefore, by preheating the inlet to the carburetor for a considerable amount, the vaporization can be ease and in turn complete combustion is achieved. Moreover by reducing the water vapor to the engine, the steam formation in the engine can be reduced. This prevents the pitting of the engine, piston and exhaust pipe. The pre-heating of inlet air to the engine can be achieved by fixing a heat exchanger in the exhaust pipe.

The atmospheric air is sucked through the heat exchanger to the carburetor. The air, which is flowing through the heat exchanger, gets heated by the engine exhaust gas, this reduces the water vapor in the inlet air and the temperature of the air is raised. The temperature raise cause complete combustion in the engine.

2. LITERATURE REVIEW

THOMAS J. HOLLIS A temperature control system in an internal combustion engine includes a heating arrangement which channels a flow of temperature control fluid from an engine to and from a heat exchanger used to preheat intake air flowing to an engine intake manifold when the ambient air temperature is relatively cold (e.g., below 20° F.). In one embodiment, the heat exchanger is mounted upstream from a throttle body. The heat exchanger consists of a panel of high capacity heat transferring fins, which are heated by heat conductive tubes wrapped around the periphery of the panel. Flow of temperature control fluid to and from the heat exchanger is regulated by a control valve which is controlled by an engine computer unit in accordance with a set of predetermined values which define a curve that is a function of engine oil temperature and ambient air temperature.

Most of the cars in today's market gives a maximum of 30 to 40 miles per gallon and hybrid cars giving up to 50 miles per gallon. The efficiency of Internal Combustion Engines used for this purpose is very low, about 25%. The heat generated during the combustion of fuel is converted into work to drive the car is wasted to the atmosphere, as anti-freeze(Ethylene Glycol) is used to cool the engine and circulated through a radiator which transfers the heat to the atmosphere. The heat generated by combustion of fuel such as gasoline or diesel is converted into the work because of the pressure created by the combustion process. In this invention, the heat is recovered by pre-heating/pressurizing the fresh air used for the process of combustion. The temperature of the pre-heated fresh air used for combustion is increased to above 1400 degrees Fahrenheit by passing through a heat exchanger to recover heat from combustible gases. Fresh air for combustion is heated to about 1400 degrees Fahrenheit. According to Thermodynamic Laws, by heating the air in a closed space with constant volume at room temperature to 1600 degrees F., the pressure is increased about to 50 psi. In order to have a higher pressure, the fresh air is first compressed up to 100 psi before passing through a heat exchanger. This will give the available working pressure of about 350 psi before injunction into the cylinders. Initially compressed, hot air is used to drive a set of cylinders. The high pressure hot air for combustion is released above 120 psi to burn in presence of fuel to drive the engine. Since the recovery of heat the efficiency is increased, an average car will give upto 4 times more mileage and hybrid cars will give 6 times more mileage between 100 and 200 miles per gallon.

3. DESCRIPTION OF EQUIPMENT

AIR-PREHEATER

An air-preheated is nothing but a heat exchanger in which heat is transferred from a hot fluid to air for useful utilization of energy. Pre-heating the air, save the fuel that would otherwise require to heat the combustion air .In addition fuel is burned more completely and the combustible materials lost is less.

While designing an air preheated the laws, which govern this process, should be well understood and thus should be used in this design, construction, testing and operation of the equipment.

TYPES OF HEAT EXCHANGER

- Double pipe heat exchanger
- Double pipe extended surface exchanger
- Shell and tube heat exchangers
- Counter flow exchanger

The above are some types of heat exchangers in this project to use the Double pipe heat exchanger this

4 .DESIGN OF AIR PRE - HEATER

The materials for tubes shall be decided first. Tubes should have very good thermal conductivity. It should also be resistant to chemical as well as erosion. Some materials that can be considered are copper, brass, aluminum and steel.
Copper has good heat conduction characteristics, but it is not recommended because of its high cost. Also copper is susceptible for easy corrosion.
1) Regarding thermal conductivity aluminum has good thermal conductivity and it is much greater than that of steel.
2) Aluminum is also highly resistant to corrosion attack. Steel has good weld ability.
3) Aluminum is light in weight and also has a bright appearance. Steel is much stronger than aluminum and could also with stand high temperature.
Considering merits of both the metals, steel is best suited for the purpose. But galvanized iron is chosen, as it is available in tube lengths in any diameter and to any required length. Also galvanized iron has very good corrosion resistance property. Further its cost is less and it can weld to G.I sheet or steel sheet.

5. PROPERTIES OF ALUMINIUM

- Abundance - aluminum is plentiful with no danger of world depletion.
- Barrier efficiency to light, gases, oils and fats, volatile compounds and water vapour
- Temperature resistance from deep-freeze to oven processing
- Heat conductivity and reflectivity
- Electrical conductivity
- Strength and durability
- Compatibility with foods and pharmaceuticals
- Ease of lamination and coating
- Flexibility
- Formability and non-returning dead-fold
- Decorative potential, brilliant or matt surface
- Printability by flexo, gravure and offset litho
- Non-toxicity
- Low weight
- Recyclability
- Corrosion resistance
- Cost-effectiveness - optimum performance yet resource economy

6. CONSTRUCTION OF PRE HEATER

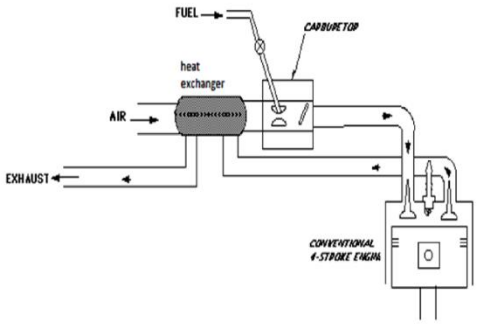
The heat exchanger is located in the engine exhaust pipe. The exhaust pipe consists of a muffler and stay plates etc. The heat exchanger is made up of M.S Plate. Outer tube of length 100 mm and diameters 55mm and inner tube of length 125 mm and 34.5mm diameter are concentrically enclosed at their ends. The inner tube is inserted tightly on the muffler tube.

A spiral baffle plate arrangement is made in between the two concentric tubes so as to make a spiral path to the incoming air. So that the heat transfer to the air can be increased. Moreover the air is flowing in counter direction to the exhaust gas thereby effective heat transfer can be achieved. The heat exchanger inlet is fitted with a pre filter.

The outlet is connected to a by-pass mechanism through a hosepipe. Preheater outer tube of material MS PLATE and dimensions 100mm length and 55mm diameter and thickness 5mm

PRE HEATER WORKING

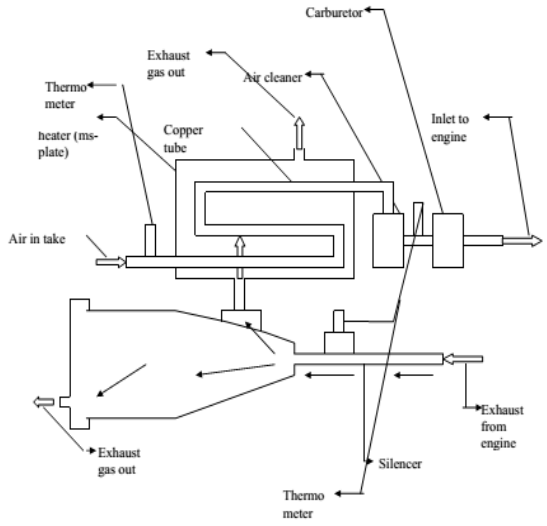
In engine working the air from the exhaust enters in to the pre-heater through inlet pipe and it circulated inside the pre-heater, the air enter in to pre heater absorb the heat from the exhaust and the hot from the pre heater enters into the carburetor inlet. The exhaust gas flow out through the outlet pipe



preheater line diagram

TEMPERATURE MEASURING INSTRUMENT SET-UP

A mille voltmeter is used to measure the temperature at various points, i.e. temperature of air at inlet & outlet of air pre-heater .The readings can be noted by the deflection of the pointer in Millie-voltmeter. One end of the thermocouple is connected to the Millie voltmeter while the other end is connected at require points on exhaust tube to measure the temperature .The thermo couple wire are perfectly insulated by glass fiber sleeves.



PERFORMANCE TEST ON MODIFIED TWO WHEELER

In the exhaust pipe of TVS Centra 100cc bike, a drill of 20 mm is drilled and a pipe is inserted on it. Then the pre-heater arranged is fitted on the top of the pipe. The fitting of the pipe & pre heater is done by welding process. In the pre-heater arrangement, a mild steel pipe of diameter 55mm and length 100mm is taken. Inside this aluminum tube of diameter 34.5mm and length 125mm is fitted in the form of spiral shape. Then the side of MS pipe is covered with two end plates. Final finishing process is done with the help of grinding process. Then the outlet of the pre-heater is connected to the filter, and then the filter is connected to the carburetor.

DESCRIPTIONS OF PARTS

S.NO	Description of Materials	Specification	Nos.
1	M.S. PIPE	100 MM	1
2	M.S. End Plates	75mm	1
3	Rubber hose	6.4 X 600 mm	1
4	Thermocouple	Copper and copper constantan	4
5	Copper tube	Die 10 mm Length 200mm	1

7. WORKING PRINCIPLE

SUCTION STROKE

When the piston moves from TDC to BDC, (suction stroke) Vacuum is created which opens the intake valve. Due to the creation of vacuum, air is drawn from atmosphere. The air passes to the pre-heater, which is preheated and increases temperature by the external flow of exhaust gases. Now, the pre-heated air passes to the carburetor in which the air petrol gets mixed in required proportions. Then the mixture is drawn into the cylinder up to the piston reaches BDC. At the end of suction stroke the inlet valve gets closed.

COMPRESSION STROKE

Now the piston moves from BDC to TDC, in which the air and petrol mixture get compressed, which results in increase in temperature. At the end of compression stroke the piston reaches TDC at the time Power stroke will starts by igniting the mixture through sparkplug. During this stroke both the valves are in closed condition.

POWER STROKE

Thus the ignited mixture produces high power which pushes the piston downwards at high pressure from TDC to BDC. During this period the mixture gets burned completely as much as higher compared to other 4stroke Petrol engines due to, "Pre-heated air ". Then the power obtained in the cylinder is transmitted to drive Wheel through connecting rod, crankshaft and flywheel. Thus there is no timing delay in burning of mixture which results in decreasing of “Knocking".

EXHAUST STROKE

During this stroke the piston moves from BDC to TDC by opening the exhaust valve. The upward movement of this stroke blows out the burned gases outside the cylinder. When the piston reaches TDC exhaust valve closes and inlet valve gets opened and suction stroke starts. Then this exhaust gas flows through the silencer through pre heater.

TESTING

TEST No. I

The first test was conducted for its actual consumption without air pre-heater connection the following steps were taken

1. The measuring jar filled with exactly 100 cc of petrol from the tank by removing tube connection to the carburetor.
2. Then the jar was hanged on the handle bar conveniently with the help of the plastic holder.
3. The connection from the fuel tank to the carburetor was disconnected and carburetor float chamber was drained completely by UN screwing the drain screw in the float chamber.
4. The carburetor was connected to the measuring jar by means of a plastic tube without making any inconvenience to the rider.
5. The breather tube of measuring jar was checked.

6. The odometer reading and the initial temperature of various thermocouples were noted down.
7. The vehicle was started and attains speed30Km/hr
8. The vehicle was driven for the entire 100 cc of fuel including the fuel in the carburetor.
9. The odometer reading and the various thermocouple readings were noted down.
10. The above procedure was repeated for 35 Km /hr& 40 Km/hr speeds.

TEST No. II

The second test was performed with same pillion rider with pre heater connection. The procedure for the test no 1 was repeated .The initial and final odometer readings and temperature were noted down for all the speeds mentioned above.

TEST No. III

The test is performed once again at 30 Km/hr& 40 Km/hr without the air pre heater. After the test is conducted, the test now performed with air pre heater. The average value obtained at various speed is tabulated

9.RESULT AND DISCUSSION

WITHOUT ATTACHMENT

Distance travel/day = 50km
Distance traveled /month = 1500km
Consumption/ liter = 0.71lit
No. of liters /month = 21.3lit
Cost of 1 liter of petrol = Rs.60
Cost of 21.3liters of petrol = Rs.127

WITH ATTACHMENT

Distance travel/day = 50km
Distance traveled /month = 1500
Consumption/ liter = .66lit
No. of liters /month = 19.8lit
Cost of 1 liter of petrol = Rs.60
Cost of 19.8 liters of petrol = Rs.1188
saving / month = 1278-1188=Rs.90

Fuel consumption was reduced due to the usage of air pre heater we can save Rs.90 per month

MERITS

Fuel consumption reduces and breaks thermal efficiency increase.
CO content in the exhaust gas slightly reduces with increase in intake air temperature.
CO2&O2 content in the exhaust gas remains unaltered in the exhaust with increase in intake air temperature.
NOX content in the exhaust gas slightly increase with increase in intake air temperature.

APPLICATION

Applicable For all Two Wheelers

10. CONCULSION

It has been identified that there are large potentials of energy savings through the use of waste heat recovery technologies. Waste heat recovery defines capturing and reusing the waste heat from internal combustion engine for heating,. It would also help to recognize the improvement in performance and emissions of the engine. If these technologies were adopted by the automotive manufacturers then it will be result in efficient engine performance and Low emission. The waste heat recovery from exhaust gas and conversion in to mechanical power is possible with the help of external setup.
It is helpful for the same amount of increases in thermal efficiency and reduction in emission .The heat input required for the engine reduces with increase in intake air temperature. Fuel consumption reduces and breaks thermal efficiency increase.
CO content in the exhaust gas slightly reduces with increase in intake air temperature. CO2&O2content in the exhaust gas remains unaltered in the exhaust with increase in intake air temperature. NOX content in the exhaust gas slightly increase with increase in intake air temperature.

REFERENCE

[1] Chirtravelan. M, Duraimurugan. K, Venkatesh. M "Design and fabrication of air pre heater for diesel engine" International Journal of Innovative Research in Science, Engineering and Technology, February 2015, pp. 149 - 154.
[2] A. Malaisamy, P. Balashanmugam"Fabrication of efficiency increaser by using preheating International Journal of Engineering Sciences & Emerging Technologies, Nov., 2015.ISSN: 22316604 Volume 8, Issue 3, pp: 166-170 ©IJESET 170 Methods "International Journal of Scientific Research, Aug 2014, pp.01 -03.
[3] Mhia Md. ZaglulShahadat, Md. NurunNabi and Md. ShamimAsher, "Diesel nox reduction by preheating inlet air "International Conference on Mechanical Engineering, December 2005, pp. 01 – 06.
[4] JaffarHussain , K. Palaniradja, N. Alagumurthi, R. Manimaran" Effect of exhaust gas recirculation (egr) on performance and emission characteristics of a three cylinder direct injection compression ignition engine" Alexandria Engineering Journal September 2012 pp. 241. - 247.
[5] J. S. Jadhao, D. G. Thombare, "Review on exhaust gas heat recovery for IC. Engine" International Journal of Engineering and Innovative Technology (IJEIT) ,June 2013 pp. 93 – 100.
[6] D.Tamilvendhan "Performance, emission and combustion investigation on hot air assisted eucalyptus oil direct injected compression ignition engine" Canadian Center of Science and Education August 2011 pp. 53 – 62.
[7] Quangang Wang, Chunde Yao , Zhancheng Dou, Bin Wang, Taoyang Wu "Effect of intake pre-heating and injection timing on combustion and emission characteristics of a methanol fumigated diesel engine at part load" Science Direct 2015 pp. 796–802.
[8] Venetia Sandu"Improving diesel engine performance by air-to-air intercooling" Bulletin of the Transylvania University of Braşov • Vol. 7 (56) No. 2 – 2014.

[9] R.G. Papagiannakis " Study of air inlet preheating and egr impacts for improving the operation of compression ignition engine running under dual fuel mode" Science Direct EnergyConversion andManagement (2013) pp. 40–53
[10] Andrew Roberts, Richard Brooks, Philip Shipway Internal combustion engine "Cold-start efficiency: a review of the problem, causes and potential solutions" Science Direct Energy Conversion and Management (2014) pp. 327–350
[1 1] V. Ganesan, Internal Combustion Engines, 3rd Edition, Tata McGraw-Hill Company, 2007,pp 369, 370, 387 – 390.
[1 2] R. K. Rajput, Internal Combustion Engines, Lakshmi publications pp 228, 238-240.
[13] V. M. Domkundwar, Internal Combustion Engines, DhanpatRai Publications.
[14] Willard W. Pulkarbek, Engineering fundamentals of the Internal Combustion Engine, Upper Saddle River New Jersey, pp. 206, 207.
[15] John B. Haywood, Internal Combustion Engine Fundamentals, 2nd Edition, Tata McGraw-Hill Company, 1988

