Fuel Efficiency Improvement in A Petrol Engine By Using Water Injection

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Abstract - In internal combustion engines, water injection, also known as anti-detonant injection, is spraying water into the cylinder or incoming fuel-air mixture to cool the combustion chambers of the engine, allowing for greater compression ratios and largely eliminating the problem of engine knocking (detonation). This effectively reduces the air intake temperature in the combustion chamber, meaning that performance gains can be obtained when used in conjunction with a supercharger, turbocharger, altered spark ignition timing, and other modifications. The reduction of the air intake temperature allows for a more aggressive ignition timing to be employed, which increases the power output of the engine. Depending on the engine, improvements in power and fuel efficiency can also be obtained solely by injecting water. Water injection may also be used to reduce NOx or carbon monoxide emissions. Finally the load test is carried out in order to find the efficiency of the engine and they are compared with that of the conventional engines.

Keywords: internal combustion engines, anti-detonant, spraying water, compression ratios, engine knocking, NOx, carbon monoxide

I. INTRODUCTION

Water has a very high heat of vaporization. As the ambient temperature water is injected into the engine, heat is transferred from the hot cylinder head/ intake air into the water. This causes it to evaporate, cooling the intake charge. A cooler intake charge means it is more dense (higher volumetric efficiency) and also will have a lower tendency to knock. However the water vapor will displace some air, negating some of the denser intake charge benefit. Knocking is generally more of a problem in forced induction engines rather than naturally aspirated so this can be a useful aid in its prevention. On electronic ignition systems the ignition timing is generally retarded to prevent knock from occurring but with water injection it can be advanced closer to Maximum Brake Torque (MBT) timing for additional power

II. MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material.

1. METAL CUTTING

Metal cutting or machining is the process of by removing unwanted material from a block of metal in the form of chips. Cutting processes work by causing fracture of the material that is processed. Usually, the portion that is fractured away is in small sized pieces, called chips. Common cutting processes include sawing, shaping (or planning), broaching, drilling, grinding, turning and milling. Although the actual machines, tools and processes for cutting look very different from each other, the basic mechanism for causing the fracture can be understood by just a simple model called for orthogonal cutting. In all machining processes, the work piece is a shape that can entirely cover the final part shape.

2. WELDING

Welding is a process for joining similar metals. Welding joins metals by melting and fusing 1, the base metals being joined and 2, the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel. Weld joints are usually stronger than or as strong as the base metals being joined. Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work and ship building.

3. DRILLNG

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (swarf) from the hole as it is drilled.

III. COMPONENTS AND DESCRIPTION

The main components of our project are given bellow.

- Engine with carburetor
- Fuel tank
- Fuel injector with nozzle
- Fuel pump
- 555 Timing controller

1. ENGINE

In this project we use SPARK IGNITION engine of the type four stroke single cylinder of Cubic capacity100cc. Engine has a piston that moves up and down in cylinder. A cylinder is a long round air pocket somewhat like a tin can with a bottom cut out. Cylinder has a piston which is slightly smaller in size than the cylinder the piston is a metal plug that slides up and down in the cylinder Bore diameter and stroke length of the engine are 50mm and 49mm respectively.

1.1 PETROL ENGINE

The engine which gives power to propel the automobile vehicle is a petrol burning internal combustion engine. Petrol is a liquid fuel and is called by the name gasoline in America. The ability of petrol to furnish power rests on the two basic principles

- Burning or combustions always accomplished by the production of heat.
- When a gas is heated, it expands. If the volume remains constant, the pressure rises according to Charlie's law.

Fig: - 1 Four Stroke SI Engine Fig: - 2 Carburator with Injector

1.2 FUNCTION

The spark ignition engine uses a highly volatile fuel, which easily vaporizes. The fuel is mixed with air before it enters the engine cylinders in the carburetor. This mixture then enters the cylinders and is compressed. Next an electric spark is produced by ignition system ignites the compressed air fuel mixture.

1.3 CARBURETOR

The carburettor has several functions it combines gasoline and air creating a highly combustible mixture, it regulates the ratio of air and fuel and it controls the engine speed. The air flow through the carburetor causes fuel to be drawn from the carburetor through the intake manifold pass the intake valve and into the cylinder .when air flows through the venturi in speed increase and pressure drops.

2. FUEL TANK

The fuel injection system requires the fuel tank to supply the fuel into the injector. This fuel tank made up of plastic materials

3. FUEL INJECTOR (OR ATOMISER) WITH NOZZLE

The injector consists of the nozzle, nozzle valve, spring and body. The fuel is forced under pressure by the fuel injection pump. The fuel lifts the nozzle valve because of the pressure, and then the fuel is sprayed through the nozzle hole. The nozzle valve is returned to its seat by the spring. Some amount of oil which is not injected passes through the nozzle valve and reaches the tank through the leak-off pipe. The purpose of the fuel injector is to inject a small volume of fuel in a fine spay and to assist in bringing each droplet into contact with sufficient oxygen to give quick and complete combustion.

4. FUEL PUMP

Fuel pump is used to circulate the fuel to the injector. In our project, the 12 Volt D.C fuel pump is used. The battery is connected to the D.C water pump, so that D.C fuel pump runs directly.

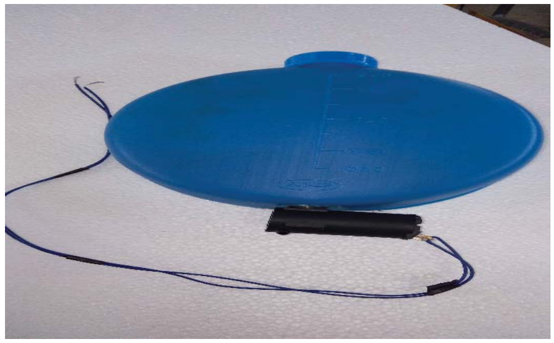

Fig: - 3 Fuel Pump with Tank

5. 555TIMER ASTABLE MODE

The capacitor C charges via R1 and R2 and when the voltage on the capacitor reaches 2/3 of the supply, pin 6 detects this and pin 7 connects to 0v. The capacitor discharges through R2 until its voltage is 1/3 of the supply and pin 2 detects this and turns off pin 7 to repeat the cycle. The top resistor is included to prevent pin 7 being damaged as it shorts to 0v when pin 6 detects 2/3 rail voltage.

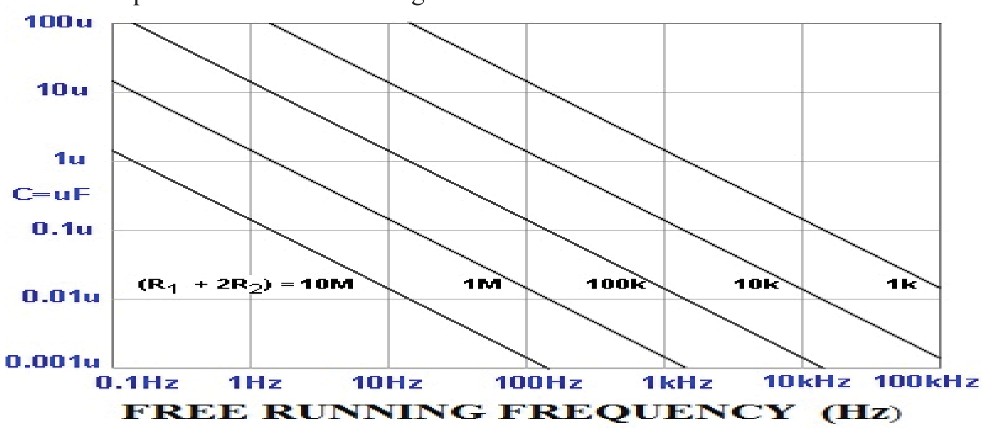

Fig: - 4 Astable Frequency Graph

Using the graph: Suppose R1 = 1k, R2 = 10k and C = 0.1u (100n). Using the formula on the graph, the total resistance = 1 + 10 + 10 = 21k the scales on the graph are logarithmic so that 21k is approximately near the "1" on the 10k. Draw a line parallel to the lines on the graph and where it crosses the 0.1u line, is the answer. The result is approx 900Hz. Suppose R1 = 10k, R2 = 100k and C = 1u Using the formula on the graph, the total resistance = 10 + 100 + 100 = 210k The scales on the graph are logarithmic so that 210k is approximately near the first "0" on the 100k. Draw a line parallel to the lines on the graph and where it crosses the 1u line, is the answer. The result is approx 9Hz.

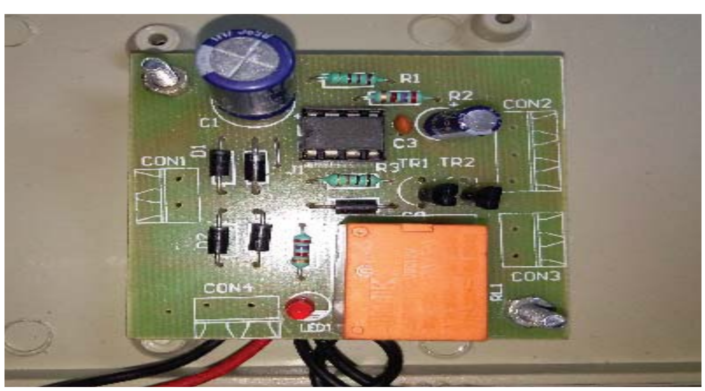

Fig: - 5 555 Timing Controller

IV. WORKING PRINCIPLE

The Pressurized fuel is given to the input supply of this fuel injector. The 12 volt pump is used to suction the water from the water tank and is given to the fuel injector. The fuel injector is controlled by the microcontroller unit. The fuel and air is supplied from the carburetor already used in the petrol engine. The 12v power supply is given to the fuel injector coil. The coil gets energized to open the nozzle hole so that the pressurized water sprayed by the injector nozzle. Engine power production, referred to as brake mean effective pressure (BMEP), is measured by taking the average effective pressure of the cylinders as they progress through intake, compression, ignition, and exhaust strokes. Added power comes as a result of greater pressure, but a higher temperature inside the cylinder accompanies greater pressure. These higher temperatures can lead to detonation, referred to as engine knock, or pre-ignition, both of which are cases where the fuel-air mixture burns in an undesirable manner and can be destructive to an engine.

V. RESULT

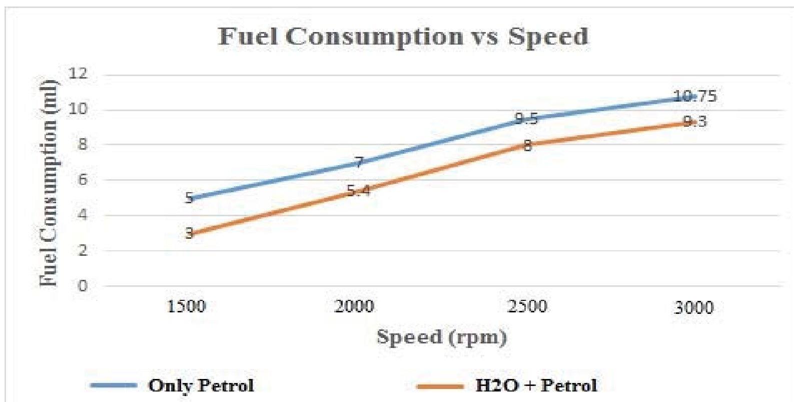

Fig:-6 Fuel Consumption vs. Speed

The aim of the experimental study was to improve the efficiency of the four stroke petrol engine by using water injection method. The experimental result is presented in fig 8. In the graph the top curve represent the fuel consumption without water injection, the second curve (bottom curve) represents that the water is injected to the intake manifold. The improvement of efficiency is observed by calculating the difference between the above two curves.

VI. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries.We are proud that we have completed the work with the limited time successfully. The “FABRICATION OF FUEL EFFICIENCY IMPROVEMENT IN PETROL ENGINE BY USING WATER INJECTION” system is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our ability and skill making maximum use of available facilities.
Thus we have developed a “FUEL EFFICIENCY IMPROVEMENT IN PETROL ENGINE BY USING WATER INJECTION” which helps to achieve the time reduction in shaping machines using pneumatic methods. By using more techniques, they can be modified and developed according to the application.

REFERENCES

[1] Rave, M.R., "Water Injection for Aircraft Engines," Trans.SAE, V.54, Nov.1946.
[2] Obert, "Detonation and Internal Coolants," Quart. Trans. SAE, Jan. 1948, pp.52-59.
[3] Nicholls, J. E. "Inlet Manifold Water Injection for Control of Nitrogen oxides - Theory and Experiment," Trans. SAE, paper 690018, 1969.

[4] Gyung-Min Choi, Masashi Katsuki, (March 2001), “Advanced low NOx combustion using highly preheated air” - Original Research Article in Energy Conversion and Management, Volume 42, Issue 5, March 2001, Pages 639- 652.

[5] Kweonha Park, Inseok Kwak, Seungmook Oh. 2004. The effect of water emulsified fuel on a motorway-bus diesel engine. KSME International Journal. 18: 2049- 2057.

[6] Bertrand D. Hsu. Combustion of water-in-diesel emulsion in an experiment medium speed diesel engine. SAE. 860300. pp. 2285-2295.

[7] M. Abu-Zaid. 2004. Performance of single cylinder, direct injection diesel engine using water Fuel emulsions. Energy Conversion and Management. 45: 697-705.

[8] Satpov, E. B. and Luksho, B.A., “A Study on the Effect of Water in Fuel on the Performance of SI Engine, " published in Engine Manufacturing in Russian, 1982.

[9] Lanzafame R, “Water injection effects in a single-cylinder CFR engine,” SAE Paper 1999-01-0568, 1999.

[10] R.B. Melton Jr., S.J. Lestz, R.D. Quillian Jr, “Direct water injection cooling for military engines and effects on the diesel cycle,” Fifteenth Symposium (International) on Combustion: Vol 15(1), 1975, 1389–1399.

[11] V. Subramanian, J.M. Mallikarjuna, A. Ramesh, “Effect of water injection and spark timing on the nitric oxide emission and combustion parameters of a hydrogen fuelled spark ignition engine,” International Journal of Hydrogen Energy: 32 (2007),1159 – 1173.

[12] R. F. Wang, Z. Q. Song, H. Yong, L. Zhao and B. Hu, “Utilizing Advanced Water Injection to develop Low Permeability Pool,” Fault-Block Oil and Gas Field, Vol. 10, No. 3, 2003, pp. 43-45.