

Fabrication of Electronic Assist Fuel Injection System in Two Stroke Engine

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ABSTRACT: Carbureted 2-stroke engines are a worldwide pandemic. There are over 50 million 2-stroke cycle engines in Asia alone, powering motorbikes, mopeds, “three-wheelers”, “auto-rickshaws”, “tuk-tuks”, and “tricycles”. These carbureted 2-stroke engines are characterized by high levels of hydrocarbon (HC), carbon monoxide (CO), and particulate matter (PM) emissions. Direct injection is a technology that has shown a great ability to reduce these emissions while at the same time improve fuel economy. A prototype kit has been designed for use in retrofitting existing carbureted two-stroke engines to direct injection. An external compressor was added to supply compressed air to the system.

The carburettor was refined with a throttle body outfitted with a position indicator, and an encoder system was added to provide speed and position feedback to the engine control unit (ECU). Once design and manufacture of the system was complete, it was installed on the motorcycle the system was also tuned in real world road tests for drivability. When calibrations were complete emissions and fuel consumption measurements were taken for the vehicle. It has been performed on a Yamaha rx135.

I. INTRODUCTION

Electronic fuel injection (EFI) replaced carburetors back in the mid-1980s as the preferred method for supplying air and fuel to engines. The basic difference is that a carburetor uses intake vacuum and a pressure drop in the venturi (the narrow part of the carburetor throat) to siphon fuel from the carburetor fuel bowl into the engine whereas fuel injection uses pressure to spray fuel directly into the engine. Fuel injection is a system for admitting fuel into an internal combustion engine.[1-3] It has become the primary fuel delivery system used in automotive engines. A variety of injection systems have existed since the earliest usage of the internal combustion engine.

The primary difference between carburetors and fuel injection is that fuel injection atomizes the fuel by forcibly pumping it through a small nozzle under high pressure, while a carburettor relies on suction created by intake air accelerated through a Venturi tube to draw the fuel into the airstream. Modern fuel injection systems are designed specifically for the type of fuel being used. Some systems are designed for multiple grades of fuel (using sensors to adapt the tuning for the fuel currently used).[4] Most fuel injection systems are for gasoline or diesel applications.

II. WORKING PRINCIPLE

The major advantages of a gasoline direct injection (GDI) engine are increased fuel efficiency and high power output. Emissions levels can also be more accurately controlled with the GDI system.[5] The gains are achieved by the precise control over the amount of fuel and injection timings that are varied according to engine load. In addition, there are no throttling losses in some GDI engines, when compared to a conventional fuel-injected or

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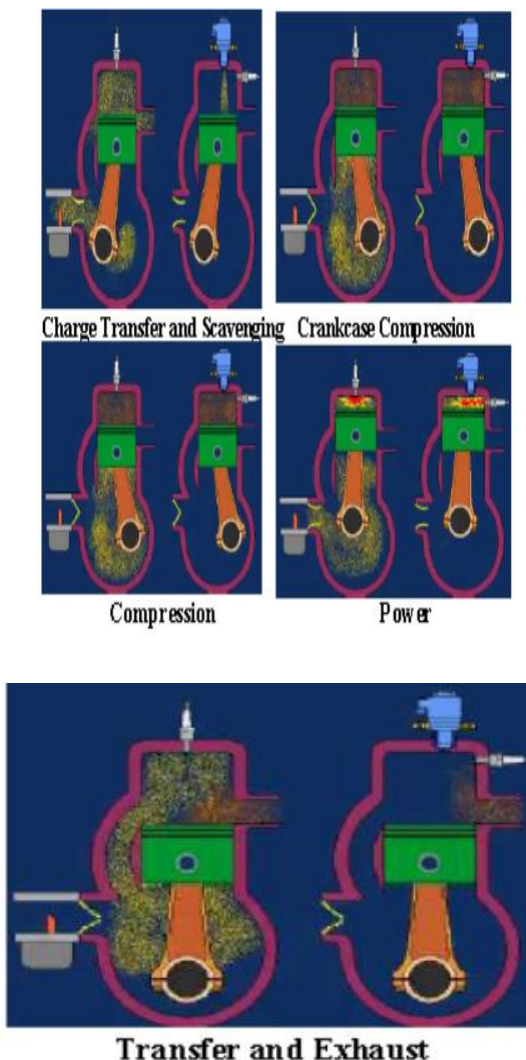
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carbureted engine, which greatly improves efficiency, and reduces 'pumping losses' in engines without a throttle plate.[6]Engine speed is controlled by the engine control unit/engine management system (EMS), which regulates fuel injection function and ignition timing, instead of having a throttle plate that restricts the incoming air supply.[7-9]Adding this function to the EMS requires considerable enhancement of its processing and memory, as direct injection plus the engine speed management must have very precise algorithms for good performance and drivability.

The engine management system continually chooses among three combustion modes: ultra lean burn stoichiometric and full power output. Each mode is characterized by the air fuel ratio. The stoichiometric air-fuel ratio for gasoline is 14.7:1 by weight (mass), but ultra lean mode can involve ratios as high as 65:1 (or even higher in some engines, for very limited periods). These mixtures are much leaner than in a conventional engine and reduce fuel consumption considerably.[10-11]

a. Comparison of 2-Stroke Carbureted SI Engine & Gasoline Direct Injection System



Fuel is injected directly into the main combustion area. The engines would have either one main combustion chamber or a divided combustion chamber made up of a primary and secondary chamber.[12]Direct fuel injection reduces hydrocarbon emission with proper design of the injection timing and the positioning of the injector. The

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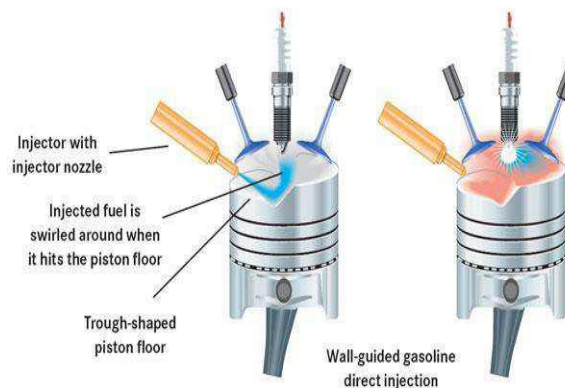
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overall gas flow in the two-stroke engine has a significant effect on the motion and evaporation of the fuel spraying process. [13]

The fuel injection system for conventional spark ignition engines injects the fuel into the engine intake system. The advantages of port fuel injection are increased power and torque through improved volumetric efficiency and more uniform fuel distribution, more rapid engine response to changes in throttle position and more precise control of the equivalence ratio during cold-start and engine warm-up. Fuel injection allow the amount of fuel injected per cycle for each cylinder to be varied in response to input derived from sensors which define actual engine operating conditions. Two basic approaches have been developed but the major difference between the two is the method used to determine the air flow rate. It is reported that parameters such as fluid flow pattern, injector location, injection timings and injection pressure effectively influence the droplet vaporization process and spatial vapour distribution in the cylinder. Fuel droplet after injection have definite amount of kinetic energy based on their mass and velocity which is truly function of pressure difference in the rail and in the cylinder.[14]

The air in the chamber during compression process is in tumble motion which produces deflection in the fuel spray. The addition air stream during the process can force the fuel stream in the center of combustion area and enhances chances that fuel droplet do not reach the cylinder and piston crown. [15-16]The development of four-stroke spark-ignition engines that are designed to inject gasoline directly into the combustion chamber is an important worldwide initiative of the automotive industry. The thermodynamic potential of such engines are significantly enhanced fuel economy, transient response and cold-start hydrocarbon emission levels has led to a large number of research and development projects that have the goal of understanding developing and optimizing gasoline direct-injection (GDI) combustion systems.

b. Direct fuel Injection System

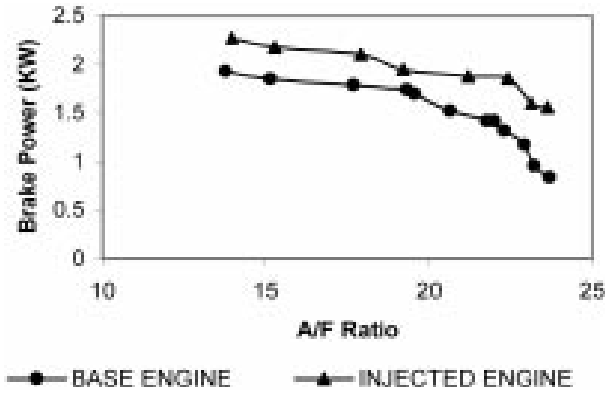


In two stroke engine when its kick started crankshaft rotates in primary gear in crank shaft Is placed in a right side of case. and magnetic coil is act as flywheel .when it rotates current Is produced.[17] In battery connection engine wiring kit has been connected and ignition is on ECM is at ready state. When battery gives power to the Yamaha r15 fuel pump from fuel pressure regulator. It pumps the fuel and send the fuel by the fuel line. and it ends with injector from the ECM gives signal to the solenoid .from the fly wheel sensor is connected to the fuel pressure sensor When injector gets signal from the ecm by the fly wheel sensor .fuel is sprayed in intake manifold Air and oil get mixed with fuel .while this cycle takes after milliseconds spark is given from the spark plug and combustion takes place. and this cycle repeats and we have used r15 fuel injection kit ,and r15 tank fuel pump and case has been altered for r15 magnetic coil as well as a fly wheel assembly In this ECM software can remapped for spark timing, fuel consumption, and finally catalytic converter exhaust is installed for a more power output and less emission this testing are summarized below in Table) 31 41 32% Distance) 4.4 0.6 88% 1.3 0.4 72%

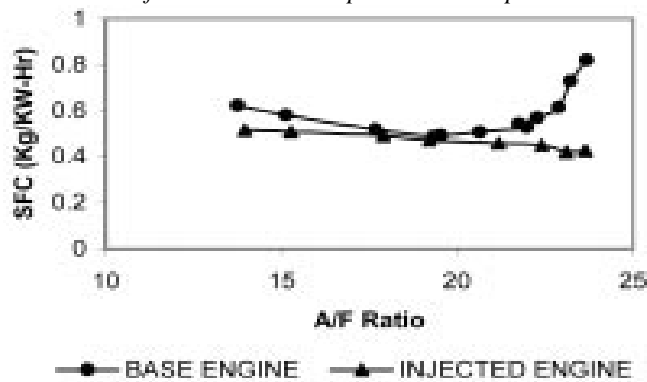
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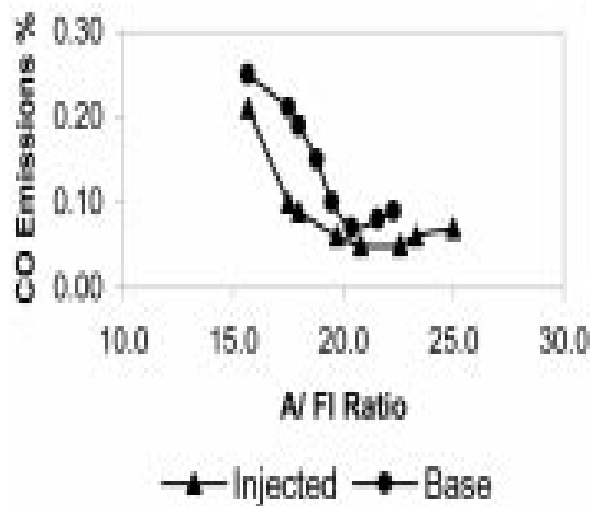
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Air-fuel ratio vs brake power at 200 rpm.



Air fuel ratio vs specific fuel consumption at 200 rpm.

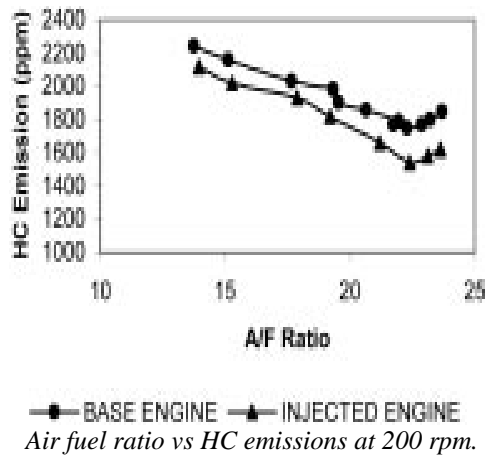


Air fuel ratio vs CO emissions at 200 rpm.

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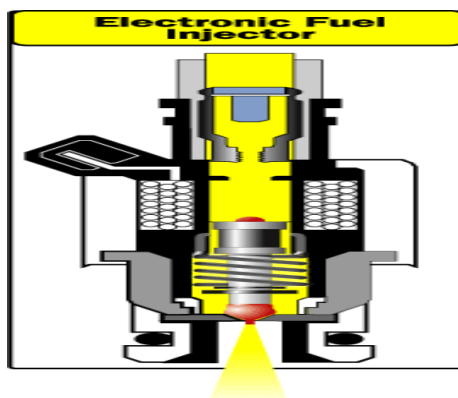
III. DESCRIPTION OF EQUIPMENT

a. Electronic Control Unit (ECU)

The Electronic Control Unit (ECU) controls the fuel injection system, ignition timing, and the idle speed control system.[18-20] The ECU also interrupts the operation of the air conditioning and EGR systems, and controls power to the fuel pump (through the control relay). The ECU consists of an 8-bit microprocessor, random access memory (RAM), read only memory (ROM), and an input/output interface. The ECU is typically located in the middle of the vehicle or beneath the front seat, where it is well protected.

b. Fuel Injectors

A fuel injector is nothing but an electronically controlled valve. [21]It is supplied with -pressurized fuel by the fuel pump in your car, and it is capable of opening and closing many times per second. When the injector is energized, an electromagnet moves a plunger that opens the valve, allowing the pressurized fuel to squirt out through a tiny nozzle. The nozzle is designed to atomize the fuel -- to make as fine a mist as possible so that it can burn easily.[22]



Electronic Fuel Injector

c. Mass Absolute Pressure(MAP SENSOR)

The manifold absolute pressure sensor (MAP sensor) is one of the sensors used in an internal combustion engine's electronic control system.

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Engines that use a MAP sensor are typically fuel injected. The manifold absolute pressure sensor provides instantaneous manifold pressure information to the engine's electronic control unit (ECU). The data is used to calculate air density and determine the engine's air mass flow rate, which in turn determines the required fuel metering for optimum combustion (see stoichiometry) and influence the advance or retard of ignition timing. A fuel-injected engine may alternately use a mass airflow sensor (MAF sensor) to detect the intake airflow. A typical configuration employs one or the other, but seldom both.[23]

d. Fuel Pump

A fuel pump is a frequently (but not always) essential component on a car or other internal combustion engine device. Many engines (older motorcycle engines in particular) do not require any fuel pump at all, requiring only gravity to feed fuel from the fuel tank through a line or hose to the engine. But in non-gravity feed designs, fuel has to be pumped from the fuel tank to the engine and delivered under low pressure to the carburetor or under high pressure to the fuel injection system.[24] Often, carbureted engines use low pressure mechanical pumps that are mounted outside the fuel tank, whereas fuel injected engines often use electric fuel pumps that are mounted inside the fuel tank (and some fuel injected engines have two fuel pumps: one low pressure/high volume supply pump in the tank and one high pressure/low volume pump on or near the engine)

e. Fuel Pressure Regulator

A fuel pressure regulator (FPR) is a device which is designed to keep the pressure in the fuel lines of a vehicle consistent. It is located between the fuel source and the engine, along the fuel rail, the line which carries fuel to the engine. This device is critical to the smooth functioning of an engine, as fluctuations in pressure can cause a variety of problems. To determine whether or not the fuel pressure regulator is working properly, a test can be performed to determine the fuel pressure; correct fuel pressure ranges vary, depending on the vehicle, and they are often listed in the owner's manual.

If the fuel pressure is too high, it can cause an engine to run rich. This increases the emissions from the vehicle, and it can cause clogging, racing, misfiring, and a variety of other problems. Low pressure makes the engine run lean, in which case the engine may take a long time to start, if it starts at all, and it may misfire, hesitate, or halt. Both of these circumstances are highly undesirable, and the FPR prevents them from happening.[25]

f. Throttle Body Position Sensor

A throttle position sensor (TPS) is a sensor used to monitor the throttle position of a car. The sensor is usually located on the butterfly spindle/shaft so that it can directly monitor the position of the throttle. More advanced forms of the sensor are also used, for example an extra closed throttle position sensor (CTPS) may be employed to indicate that the throttle is completely closed. Some engine control units (ECUs) also control the throttle position electronic throttle control (ETC) or "drive by wire" systems and if that is done the position sensor is used in a feedback loop to enable that control. Related to the TPS are accelerator pedal sensors, which often include a wide open throttle (WOT) sensor. The accelerator pedal sensors are used in electronic throttle control (ETC) or "drive by wire" systems, and the most common use of a wide open throttle sensor is for the kick-down function on automatic transmissions

IV. CONCLUSION

The elimination of fuel waste and emissions has been intensively studied over the past few decades. One of the best methods for solving the above problem was identified as electronic fuel injection. In this work, a successful virtual instrumentation program was developed using software to run a two-stroke SI engine in injection mode. The injected engine shows an overall performance improvement compared to the base engine. The injected engine shows very good improvements in brake power when compared to the base engine. The injected engine shows less fuel consumption. The brake thermal efficiency of the injected engine was higher when compared to the base

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engine. The CO and HC emissions were less in comparison with the base engine and the injected engine produced higher peak pressure this research work successfully.

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