

Design of Twin-Charged Quadruple Spark Ignition W20 Engine

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Abstract: *Internal Combustion Engines, are used for daily transportation of various types of goods as well as transportation of Humans, is also runs in Formula 1 races with Higher power Performance as compared to daily Road running engines. Formula 1 Engines are known for their High Power Output but they are not performing very well in the manner of Fuel Efficiency. In another hand, Daily Road Running Engines are getting great numbers in Fuel Efficiency but they are fails to achieve High Power Output. This research introduced Twin-Charged Spark Ignition Engine for achieving above major criteria which are very much important in Automobile Industry. Twin-Charged Spark Ignition Engine is performs on the basis of Formula 1 Engine theory for daily running road Four Stroke Spark Ignition car engine. This new designed engine comes with combination of both Turbocharger and Supercharger for getting extra Massive Power, and also to control Air Pollution and maintaining Fuel Efficiency Quadruple Spark Ignition System is used.*

Keywords: Twin-Charged Engine, Quadruple Spark Ignition System, Turbocharger, Supercharger

1. Introduction

This research is about to introduced Twin-Charged car Engine which performs better in Fuel Economy and also obtaining Maximum Power Output. To improving in power output this engine comes with combination of Turbocharger and Supercharger both. The advantages of Twin –Charged engine are:

1. To obtaining Extra Power Output.
2. Combination of Turbocharger and Supercharger are helps to overcome the disadvantages of Single operating Turbocharger or Supercharger.
3. Aim for this engine is perform on the basis of Formula 1 Engine theory and this aim is fulfilled by using Twin-Charger to Engine.

This newly designed W20 Car Engine is also come with Quadruple Spark Ignition System for achieving better Fuel Efficiency.

Quadruple Spark Ignition System shows some advantages as:

1. More Brake Power.
2. More Fuel Efficiency.
3. Less Exhaust Pollution.

Quadruple Spark Ignition System utilized more Air-Fuel mixture which displaced in Engine Cylinder and there after the system gives much better results in above categories of Internal Combustion Engine.

Both the newly designed technologies which described early in content shows equilibrium in the manner of Power Output and Fuel Efficiency for future designed W20 Engine.

From various theoretical calculations this engine gives good results in above categories which are very much important in Engine performance.

2. Literature Survey

1. Performance And Emission Analysis Of Two Stroke Four Spark Plug Single Cylinder SI Engine With Gasoline Fuel by Hardik A. Patel, J. J. Goswami:

Professor Hardik Patel and J. Goswami present their analysis for improving engine performance by using four spark plugs to the single cylinder two stroke SI engine. They conclude that using four spark plugs to the two stroke engine, performance of engine get improved in:

1. Unburned Hydro Carbon emission gets lower.
2. Brake Thermal Efficiency increased.
3. Brake Specific Fuel Combustion reduced.
4. More Power generated.

2. Video Documentary on Bugatti Veyron posted by National Geographic Channel on Social Networking Site YouTube:

This video documentary describes about massive 1000 BHP (Brake Horse Power) engine of Bugatti Veyron 2016 edition. The W16 engine of Bugatti Veyron produced 1001 BHP with approximately 1500 Nm Torque. Also in this video various useful replacements for obtaining the massive power are briefly discussed.

Link: https://www.google.co.in/url?sa=t&source=web&rct=j&url=%23&ved=0ahUKEwi7lrGZ7ZnVAhUFTbwKHUSXAoQQxa8BCB0wAA&usg=AFQjCNF1sHik2z9QIx28jtvfnGP_UlkifA

3. Video Documentary on Formula 1 race car Engines posted by Discovery Channel on Social Networking Site YouTube:

This video documentary describes the Science behind performing Formula 1 Race Car Engines, and also helps to understand the physics behind optimized high speed engines which runs up to 20000 RPM and more.

Link: <https://www.google.co.in/url?sa=t&source=web&rct=j&url=%23&ved=0ahUKEwiyg46L7pnVAhVEwrwK>

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4. Performance Study on Twin Plug Spark Ignition Engine at Different Ignition Timings by Narasimha Bailkeri, Krishna Prasad, Shrinivasa Rao B.

Sir Narasimha Bailkeri, Sir Krishna Prasad and Sir Shrinivasa Rao B. conclude in their research that when Twin Spark Plugs are in Engine at different ignition timing engine performs better than single Spark Ignition Engines. Also Twin Spark Plugs gives more sparks at different ignition timing as compared to Single Spark Ignition engines. They conclude following results in their research as:

1. Brake Power of engine increases at different ignition timings.
2. Exhaust is significantly reduced.

5. Various articles about Formula 1 Engines published globally on Wikipedia:

Those articles on Wikipedia shows detail information about Performance and Testing of Formula 1 Engines.

3. Engine Specifications

Engine Diameter	90 mm
Stroke Length	120 mm
Displacement of Engine	15268140 mm ³
Total Cylinders	20
Strokes/Cycle	04
Valves/Cylinder	04
Cooling System	Water Cooled
Lubrication System	Dry Sump Lubrication

Mathematical analysis of Engine Performance

Technical Measurements:

Maximum Power	1119 kw
Maximum Torque	877.92 Nm

Engine Fuel Consumption Calculations:

Fuel Used	Petrol
Calorific Value of Fuel	44000 KJ/Kg
Specific Gravity of Fuel	0.75
Fuel Consumption/Hour	261.72 Kg/Hour

Engine Air Consumption Calculations:

Air Consumption/Hour	3925.8 Kg/Hour
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Note: Above value for Air-Consumption per Hour is getting from Theoretical and Mathematical Calculations. After Practical use of Twin-Charger to W20 Engine value of Air Consumption per Hour may be changed.

Engine Efficiency Related to Various Factors:

Mechanical Efficiency	85%
Air Standard Efficiency	65.20%
Relative Efficiency	63.15%
Volumetric Efficiency	57.85%
Indicated Thermal Efficiency	41.18%
Brake Thermal Efficiency	35%

Note: The various Efficiencies of W20 Engine are calculated on the basis of various Theoretical and Mathematical values which are calculated as per requirement. Use of Twin-Charger in W20 Engine may affect o some of the above Efficiencies of W20 Engine.

4. Ignition System

To obtaining Higher Output Voltage **Quadruple Spark Ignition System (QSI System)** is used in this W20 Spark Ignition Engine. In this system Four Spark Plugs are used for Single Cylinder of W20 engine to obtain multi sparks at same time. Two of them act as **Boss Spark Plugs** which produces spark at the Crank Position is at TDC and remaining two of them act as **Employee Spark Plugs** which produces spark just after Crank Position is quite below to TDC.

Location of Spark Plugs:

1. Boss Spark Plugs located middle of the Combustion Chamber.
2. Employee Spark Plugs located corner of the Combustion Chamber with Inclined to Boss Spark Plugs at 45⁰ and also opposite to each other.

This Spark Ignition System better perform with **Electronic Control Unit** because due to ECU System each Spark Plug has able to maintain their required Voltage. ECU System passes required amount of Voltage to the Spark Plugs for smooth performance hence Quadruple Spark Ignition System having some advantages as:

1. Reduce Ignition system maintenance.
2. Reduce wear of the Components.
3. Increased Reliability.
4. Extended Spark Plug Life.
5. Improved ignition of Lean Mixture.
6. More Combustion takes place during operation.
7. Reduce Exhaust Pollution.
8. Obtain more Power for Engine.

Twin-Charger

Twin-Charger is the combination of both Supercharger and Turbocharger. In this future designed W20 engine Twin-Charger is used for improving Power Output. Due to maximum amount of hot compressed air generated by both Supercharger and Turbocharger this W20 engine produces more Output Power. This Twin-Charger uses Exhaust gases which are coming from working cycles of W20 engine for producing fresh Compressed Air that required to obtaining maximum Output Power.

Due to utilization of Exhaust Gases, this W20 engine also perform very well in the manner of Air Pollution Control which is much important in today's era.

Finally, the disadvantage of single Turbo Engine and single Supercharge Engine is overcome by using combination of both Supercharger and Turbocharger in this Twin-Charged W20 Spark Ignition Engine.

5. Conclusion

Based on above mathematical data, this Twin-Charged Spark Ignition W20 Engine gives better numbers in the manner of efficiencies as well as power developed. After several mathematical calculations following conclusions are made:

1. Multipoint sparks helps to improve in total combustion of fuel hence engine gives more power due to maximum amount of air-fuel mixture used during operation.
2. This engine gives maximum fuel efficiency because of more amount of air-fuel mixture can burn inside the cylinder during one cycle.
3. Multiple sparks also reduced Carbon- dioxide percentage which coming from exhaust.
4. Unburned Hydro Carbon emission is significantly reduced in this W20 engine.
5. Using of Twin-Charger helps to increase Power Output of this W20 engine.
6. Exhaust Gases are also come in picture due to their use in Twin-Charger for generating Fresh and Hot Compressed Air which is required to Combustion of Fuel during engine performance.
7. Twin-Charger is also increases Engine Speed and helps to produce more Power inside the engine.
8. Volumetric Efficiency of W20 Engine is increased due to use of Twin-Charger.

References

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