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REVIEW ON THE PERFORMANCE IMPROVEMENT OF TWO WHELLERS USING MODIFIED SUPERCHARGER

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Abstract— The improvement in performance of IC engine by implementing a supercharger. Moreover, there are several modification made in the design of the supercharger to obtain optimum performance by varying the parameters which can improve the performance. Supercharging provides better combustion condition, torque as well as it also decreases the consumption of fuel as well as exhaust. Inlet pressure is the parameter that is focused upon as it will increase the compression ratio and eventually the efficiency. In existing supercharger there is problem of loss of power and rpm is reduced if it is directly mounted to engine crankshaft. The project aims to modify existing supercharger by using gear pinion arrangement between compressor and crankshaft to overcome power loss.

Keywords – Supercharger, Naturally Aspirated Engine, Inlet Pressure, Power Output, Performance

I. INTRODUCTION

Nowadays there is a great increment in the industrialization and the use of vehicles as motorization of the world. This leads the world to an abrupt rise in the demand for petroleum products which are stored under the surface of the earth. As in the current stage, we have limited reserves of these stored fuels and it is very difficult to replace. These finite and limited resources of petroleum are highly available in certain regions of the world. So it has given rise in fluctuations and uncertainties in its price as well as supply. In the current year, substantial research for the development of supercharger is made with various kinds of supercharger technology with the aim to obtain a higher output performance of vehicle engines. The development of supercharger technology is led due to the decisive role of its characteristics, producing an outstanding increase in power of the engine and mean effective pressure. A supercharger is a device to increases the density or pressure of air which is supplied to an internal combustion engine

II. DIFFERENT TYPES OF SUPERCHARGER

A. Centrifugal supercharger

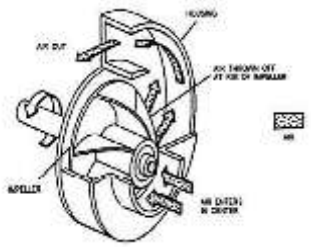

Fig. 1 Centrifugal Supercharger

A centrifugal type supercharger is the best elementary and most common used supercharger. A centrifugal supercharger works a lot similar to a centrifugal blower fan, having an inlet port, a scroll, an impeller and a discharge port. The air comes in the inlet port of supercharger and is knocked out by an impeller. The impeller needs to rotate at the speeds of 4000 - 6000 rotations per minute in order to generate boost. At idle speeds, the impeller does not rotate with sufficient speed to gain any boost. The impeller consumes centrifugal forces in order to yield boost.

B. Roots Supercharger

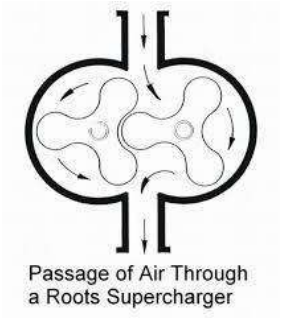

Fig. 2 Roots Supercharger

The roots type supercharger is consist of two counter-rotating interlocked lobed rotors. The two rotors setup air, in the openings between rotors and push it in contradiction of the compressor housing as they rotate in the direction of the outlet/discharge port. As with all positive displacement blowers, boost is openly connected to the speed of the lobes. The roots supercharger is mainly used for low-rpm boost. The roots blower is highly suitable pressure ratio of 1.2 to 2 as it is simple in construction, low cost and higher mechanical efficiency. The volumetric efficiency decreases rapidly with an increase in pressure ratio. The roots superchargers are suitable for low and medium speed engine as well as for stationary and marine engines.

C. Vane Supercharger

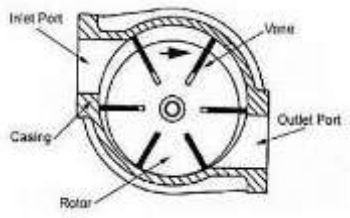

Fig. 3 Vane Supercharger

Vane type supercharger is a positive displacement rotary type supercharger. This consists of a rotor which revolves inside a large cylindrical casing. The rotor has four slots which is connected with the casing at least at one point all the time. The axis of the rotor is mounted eccentrically and blades slide radially in and out of the slots of the rotor. As it moves, the air is trapped in between two immediate vanes and as the rotor rotates, the volume of air goes on reducing and so on increasing the pressure. The vane supercharger is very rarely used on cars, yet its design displays in other requests.

D. Screw Supercharger

Fig. 4 Screw Supercharger

A twin-screw supercharger works by drawing air through a pair of meshing lobes that look like a set of worm gears. Like the Roots supercharger, the air inside a twin-screw supercharger is trapped in pockets generated by the rotor lobes. But a twin-screw supercharger compresses the air inside the rotor case. Because of that, the rotors have a pointed taper, which means the air pockets

reduction in size as air moves from the fill side to the release side. As the air pockets shrink, the air is compressed into a smaller space.

E. Axial flow supercharger

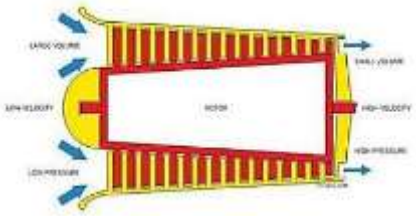

Fig. 5 Axial flow Supercharger

An axial flow compressor compresses a large volume of low-pressure air at low velocity into a small volume of high-velocity air at high pressure. The rotating blades draw air into the compressor. These rotating blades induce a velocity, also known as kinetic energy. When the air contacts the stators, which is in the compressor assembly, it reduces the velocity and converts part of the kinetic energy into static pressure and heat. The mass airflow is then directed to the next set of rotating blades. This process is then repeated through each stage until the desired pressure is obtained. In the axial flow compressor, high pressure is generated. Output pressure is increased by divergence in each static inter stage section.

III. PURPOSE OF SUPERCHARGER

Supercharging is a process which helps to increase the suction pressure of IC Engines above the atmospheric pressure. The main objective of supercharging is to increase the amount of air per cycle. Due to access amount of air in charge , permits the better combustion of fuel compare to aspirate. Thus the power output of the engine is increased. Purpose of supercharging is to raise the volumetric efficiency above that which can be obtained by normal configuration. The engine is an air pump. Increasing the air consumption permits grater quantity of fuel to be added and results in a greater potential output. The produced indicated power is almost directly proportional to the air consumption of engine. While break power is not so closely related to air consumption. However, it is dependent upon the mass of air consumed. It is desirable that the more amount of mass of air is being consumed by the engine.

It is preferred to fulfill the following requirements:

1. To reduce the weight of engine per kW
2. To increase the power of an existing when the greater power demand occurs
3. To overcome effects of high altitude
4. Reduction in HC and CO emission
5. Increased volumetric efficiency and load carrying capacity.

IV. LITERATURE REVIEW

Table. 1 Literature Review

Research Paper	Published Date	Conclusion
Experimental Analysis of Spark ignition Engine (below 100 cc) with supercharger using e10 fuel	April-May 2014	-According to research paper we conclude that With increase in load brake specific fuel consumption decreases for both engine with & without supercharger -Literature review shows loss of mechanical power to drive the supercharger at low speed.

Performance Analysis of Supercharging a Single Cylinder SI Engine	December-2015	It is possible to install a supercharger for a commercial two wheelers which increases their horsepower on an average about 150 % more than the original engine.
Performance Analysis Of Supercharging Of Two Wheelers	May-July 2011	Torque of the modified engine is highest at 7000 rpm and after that there is decrement of the torque due to the fast opening and closing of the valves of the engine .
A review paper on the use of the supercharger in small size vehicle	May 2013	By modifying the naturally aspirated engine, the supercharged application gets effects in all of internal combustion engine by obtaining more power from given size of the engine.
Alternative solutions for supercharging with aggregate of turbocharger type	June 2011	Compared with turbocharge, supercharger has the advantage of a fast response in acceleration.

V. EXPERIMENTAL SETUP

A Single Cylinder, four stroke, the petrol engine is used for the purpose of experimentation. The engine is then coupled to a rope brake dynamometer. Cooling water is circulated separately to the rope brake pulley.

The experiment will be conducted on pulsar's petrol engine. The experiment work towards the engine performance enhancement is done in these following steps. The engine is having kick start.

1. The performance of the engine when fuelled with gasoline.
2. The performance of the supercharged engine with gasoline.
3. The performance of supercharged engine including gear-pinion arrangement with gasoline.

A. Experimental Procedure

1. Check the fuel level in fuel tank.
2. Check the connections of engine mounting.
3. Start the engine with starting device.
4. Measure the rpm of the engine with tachometer.
5. Measure the rpm of engine at different acceleration level and note them.
6. Now compare the result data, the rpm of engine improves at same acceleration level without supercharger, with supercharger & with gear pinion arrangement.
7. Concluding the result of the experiment and analysis the data from experiments.

At the beginning of the performance of the supercharged engine, the readings were taken on the engine without modification for the base data results. So the comparison is based on that reading.

Fig. 6 Experimental Setup

B. Block Diagram for Test on the Engine with Supercharger including Gear-Pinion Arrangement.

As shown in block diagram first of the entire engine is coupled with starting device. Then the engine is connected to acceleration device as acceleration pedal. The power of the engine is measured under connectivity rope brake dynamometer. Tachometer will be used for measuring the rpm of the engine. The level of air supply is measured by U-Tube manometer.

The additional supercharger as the centrifugal blower operated motor is connected to gear-pinion arrangement and then carburetor.

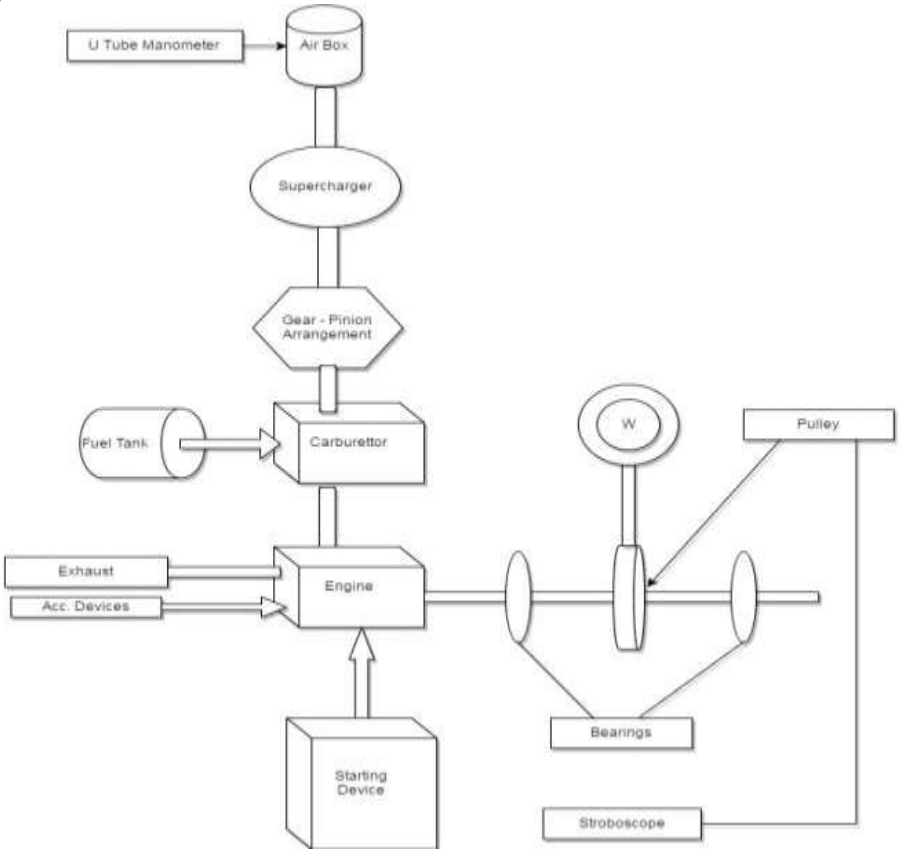

Fig. 7 Block Diagram for Test on the Engine with Supercharger including Gear-Pinion Arrangement

C. Reading table (without supercharger)

Table.2 Reading Table (without supercharger)

Sr .no	Load (kg)	GEAR	Engine Speed (RPM)	Difference of manometer reading (cm)	Time for 5ml fuel consumption (sec)	Wheel Speed (RPM)	Torque (Nm)	Break Power (kW)	Total Fuel Consumption (kg/hr)	Thermal efficiency (%)	BSFC (kg/kw.hr)	Mass of air (kg/hr)	BSEC (kJ/kW hr)
1	0	N	7100	1.1	61.23	0	0.000	0.000	0.216	0.00		6.58	
2	0	1	7003	1.15	60.03	3885	0.000	0.000	0.220	0.00		6.73	
3	0	2	6910	2.13	29.7	3990	0.000	0.000	0.222	0.00		9.16	
4	0	3	6695	2.45	56.9	4120	0.000	0.000	0.233	0.00		9.82	
5	3	N	6700	1.2	62.4	0	1.912	0.000	0.212	0.00		6.87	
6	3	1	6610	1.35	61.10	3570	1.912	0.714	0.217	24.60	0.304	7.29	14592
7	3	2	6475	2.17	60.21	3630	1.912	0.726	0.220	24.75	0.303	9.24	14544
8	3	3	6250	2.8	59.2	3850	1.912	0.770	0.224	25.78	0.290	10.50	13920
9	5	N	6505	1.27	63.77	0	3.190	0.000	0.208	0.00		7.07	
10	5	1	6320	1.37	62.6	3425	3.190	1.027	0.211	37.03	0.205	7.34	9840
11	5	2	6270	2.4	61.1	3515	3.190	1.054	0.271	36.42	0.206	9.72	9840
12	5	3	6103	3.7	60.2	3810	3.190	1.143	0.220	38.96	0.192	12.07	9216
13	9	N	5998	1.4	65.2	0	5.738	0.000	0.203	0.00		7.42	
14	9	1	5865	2.6	62.2	3270	5.738	1.962	0.209	70.40	0.106	10.12	5088
15	9	2	5377	2.85	62.05	3460	5.738	2.076	0.212	73.44	0.102	10.59	4900
16	9	3	5117	3.95	60.07	37775	5.738	2.265	0.220	77.21	0.09	12.47	4656

D. Reading Table (With Supercharger)

Table.3 Reading Table (With Supercharger)

Sr.no	Load (kg)	GEAR	Engine Speed (RPM)	Difference of manometer reading (cm)	Time for 5ml fuel consumption (sec)	Wheel Speed (RPM)	Torque (Nm)	Break Power (kW)	Total Fuel Consumption (kg/hr)	Thermal efficiency (%)	BSFC (kg/kw.hr)	Mass of air (kg/hr)	BSEC (kJ/kW hr)
1	0	N	7100	1.23	58.23	0	0.000	0.000	0.227	0.00		6.96	
2	0	1	7003	1.19	57.33	4005	0.000	0.000	0.231	0.00		6.84	
3	0	2	6910	2.19	56.66	4105	0.000	0.000	0.234	0.00		9.28	
4	0	3	6695	2.5	53.77	4350	0.000	0.000	0.246	0.00		9.92	
5	3	N	6700	1.27	59.7	0	1.912	0.000	0.222	0.00		7.07	
6	3	1	6610	1.39	58.23	3770	1.912	0.723	0.275	19.71	0.380	7.40	18240
7	3	2	6475	2.25	57.33	3981	1.912	0.761	0.231	24.70	0.303	9.41	14544
8	3	3	6250	3.25	56.27	4270	1.912	0.816	0.235	26.04	0.287	11.3	13776
9	5	N	6505	1.30	62.78	0	3.190	0.000	0.211	0.00		7.15	
10	5	1	6320	1.48	61.7	3751	3.190	1.196	0.215	41.72	0.179	7.63	8592
11	5	2	6270	2.74	59.22	3875	3.190	1.236	0.224	41.38	0.181	10.39	8688
12	5	3	6103	3.67	57.29	4105	3.190	1.309	0.231	42.5	0.176	12.04	8448
13	9	N	5998	1.57	64.57	0	5.738	0.000	0.205	0.00		7.86	
14	9	1	5865	2.99	61.20	3541	5.738	2.031	0.216	70.52	0.106	10.85	5088
15	9	2	5377	3.49	61.09	3761	5.738	2.158	0.217	74.58	0.100	11.72	4800
16	9	3	5117	4.22	58.44	4270	5.738	2.450	0.227	80.94	0.092	12.89	4416

E. Reading Table (With Modified Supercharger)

Table.4 Reading Table (With Modi. Supercharger)

Sr. no	Load (kg)	GEAR	Engine Speed (RPM)	Difference of manometer reading (cm)	Time for 5ml fuel consumption (sec)	Wheel Speed (RPM)	Torque (Nm)	Break Power (kW)	Total Fuel Consumption (kg/hr)	Thermal efficiency (%)	BSFC (kg/kw.hr)	Mass of air (kg/hr)	BSEC (kJ/kW hr)
1	0	N	7100	1.47	57.21	0	0.000	0.000	0.231	0.00		7.34	
2	0	1	7003	1.29	56.50	4205	0.000	0.000	0.234	0.00		7.14	
3	0	2	6910	2.22	56.15	4337	0.000	0.000	0.236	0.00		9.36	
4	0	3	6695	2.61	54.14	4467	0.000	0.000	0.245	0.00		10.14	
5	3	N	6700	1.38	58.62	0	1.912	0.000	0.226	0.00		7.37	
6	3	1	6610	1.41	57.87	3970	1.912	0.759	0.229	24.85	0.300	7.45	14400
7	3	2	6475	2.29	56.89	4105	1.912	0.784	0.233	25.23	0.290	9.49	13920
8	3	3	6250	3.37	55.22	4401	1.912	0.841	0.240	26.28	0.289	11.52	13440
9	5	N	6505	1.34	62.11	0	3.190	0.000	0.213	0.00		7.40	
10	5	1	6320	1.51	60.55	3997	3.190	1.275	0.219	43.66	0.179	7.71	8160
11	5	2	6270	2.77	58.78	4117	3.190	1.313	0.225	43.76	0.175	10.44	8160
12	5	3	6103	3.69	56.91	4337	3.190	1.383	0.233	44.51	0.165	12.05	7680
13	9	N	5998	1.61	63.81	0	5.738	0.000	0.208	0.00		7.96	
14	9	1	5865	3.01	60.47	3841	5.738	2.203	0.219	75.44	0.092	10.89	4320
15	9	2	5377	3.57	59.13	4057	5.738	2.327	0.224	77.91	0.091	11.85	4320
16	9	3	5117	4.61	57.79	4561	5.738	2.616	0.229	85.67	0.080	13.47	3840

VI. COMPARATIVE ANALYSIS

In this effort, the performance of supercharged Bajaj Pulsar 150cc Engine is discussed on the foundation of experimental examination. Intake of atmospheric air has increased the combustion characteristics of conventional engine and also increases the engine power output by increasing the intake pressure above ambient pressure. Moreover, the gear pinion arrangement increases the rpm of supercharger's shaft compared to rpm of engine shaft. The result is showing the comparison between the performance parameter of the modified supercharged engine, supercharged engine and conventional engine.

A. Performance parameters

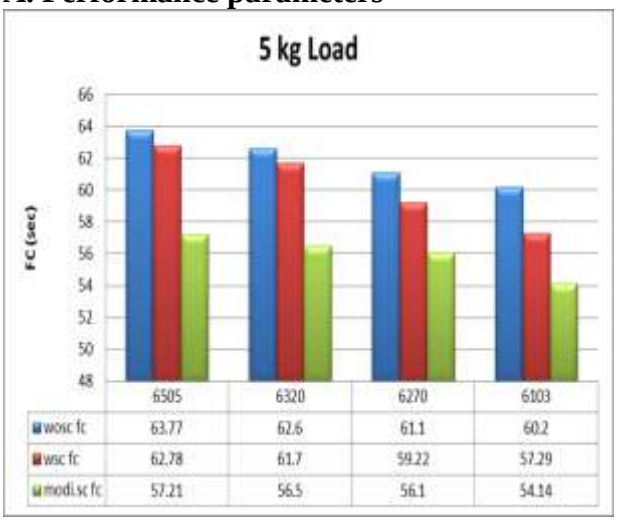

Fig. 8 RPM v/s Fuel Consumption

Fig. 9 RPM v/s Brake Power

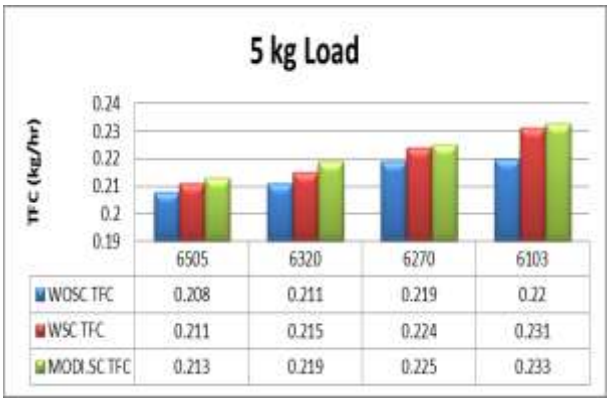

Fig. 10 RPM v/s Total Fuel Consumption

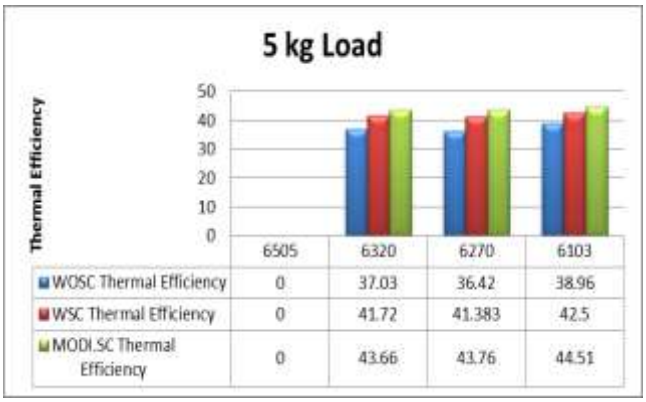

Fig. 11 RPM v/s Thermal Efficiency

Fig. 12 RPM v/s BSFC

Fig. 13 RPM v/s BSEC

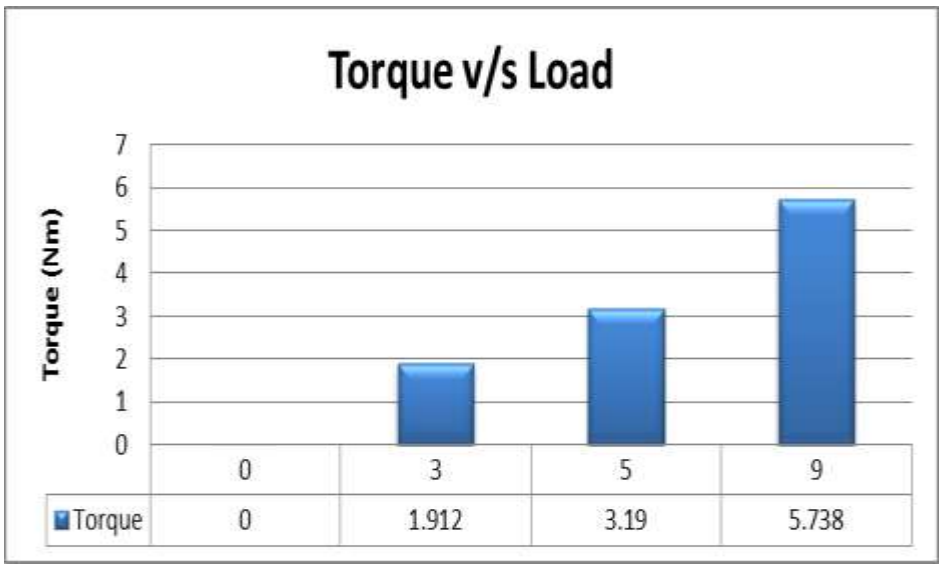

Fig. 14 Torque v/s Load

VII. CONCLUSION

- It is concluded that existing supercharger can be modified by gear pinion arrangement to increase the rpm of supercharger to get more power output at the same acceleration level compared to existing supercharged engine.
- The centrifugal type supercharger is more efficient among all type.
- By experimental reading it is noted that in different loading condition and gear condition increase in brake power is about 5% and thermal efficiency about 4.5%.
- Brake specific fuel consumption is decreased by 5% in modified supercharged engine compared to supercharged engine.
- Total fuel consumption is increased by 1.5% in modified supercharger.

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