

Development of Compressed Air Charged Vehicle

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Abstract:

Air powered vehicles are those which can run on no external aids. In spite of electrical vehicles, this vehicle does not wait for recharging for longer period of time. Refueling is easier and can be done in fraction of minutes. Most importantly it is having utmost same efficiency without compromising any kind of losses. At present the air technology in the automobile sector is very scarcely been used because of their low range of travel with single fueling. Our system deals with an attempt to make a more efficient air engine to give few more miles to get incorporate with. An attempt is made to convert two wheeler in compressed air charged rotary engine system, by providing air drive with specialized air tank which can hold up to 300bars or 4000psi of pressurized air to reduce space required for fuel (air). Rear wheel drive will serve initial pick up torque which will help the required modifications to vane angle as low as possible.

Keywords: Rotary Engine, Compressed Air, Vane, Alternate Energy, Automobile.

Introduction:

Because of global problems such as greenhouse effect, ozone layer depletion, acid rain, air pollution our total life of our planet is reducing day by day. These factors are leading automotive technology and development of alternative energy sources. Some of them are electrical powered, solar powered, hydrogen powered, etc. but before we utilize and Compressed air is having energy stored within. This energy can be converted into required output by expanding it to atmospheric pressure. This air without external chemical or physical support is having potential to generate output work. As it is green and clean type of energy environment and roadside issues can be neglected. We are planning to replace four stroke fossil fuel engines with air charged rotary engines. Without any complexity, we are planning to develop three vane type rotary engines with rotor diameter of 30 ± 2 mm for automotive use. And we are planning to introduce new materials to amplify life and workability of machine as prescribed below.

Vehicle's Category	Fuel Economy (kmpl eq.)	Range	Production Cost for given range	Reduction in CO ₂	Major Pollutants	Maintanance Grade	Speed Range (kmph)
Conventional I.C.Engine	10 to 78	Long	Medium	0%	CO, HC, NO _x , etc.	Medium	50 to 447
Biodiesel	18 to 71	Long	Medium	20%	Aldihydes, CO, Particulate Matter	High	50 to 200
All-Electric	Battery (upto 30)	Shorter (75-100)	High	100%	Lead, Acid Wastes, SO ₃ , etc.	Extremly High	50 to 250
Compressed Air	30 to 60	50 to 75	Low	100%	None	Low.	50 to 150

Table 1: Statics of today's Technology

METHODOLOGY:

With low aspects assumed we can manufacture, vane type rotary engine which runs on rotary compressed air, to optimize its performance with respect to automobiles. The design of this system can replace four stroke and 2 stroke single cylinder air cooled 100-150 cc engines, in bikes. Following steps are incorporated in development of air charged vehicle:

1. Designing of rotary engine.
2. Fabrication approach.
3. Assembly.
4. Stationary Testing.
5. Final Testing.
6. Cost report.
7. Supply and help ventures.

Following design is an assembly of final product been manufactured? Moreover, development of this design is according to rotor to casing diameter as per researched in earlier era. Dimension mentioned in diagrams are having tolerance limit of $\pm 0.03\text{mm}$. Actual manufactured parts are prepared in three sets for safer test and flawless set up. But only one set served the system analysis until now. Including Pressure vessel and pressure regulator are as per specification and are not designed by us. They were compared to our specifications and bought as per requirement. Accelerator is a mechanical linkage controlled by wire drive and was chosen because of their greater life and reliability.

PART NAME	MANUFACTURING PROCESSES
Motor casing	Casting, turning, threading, Drilling
Mother Plate	Turning, Drilling
Rotor	Turning, Grinding, Milling
Rotor Casing	Casting, Drilling, Turning, Grinding
Vane Blades	Punching
G geared Shaft	Milling, Grinding
Cover Plates	Casting, Turning
Hose	Cutting, Clamping
Air Cylinder	Readymade
Pressure Regulator	Readymade
Hose holding clips	Readymade
Multi Step Shaft	Turning, Threading, Grinding, Milling
Pressure vessel Mountings	Cutting, Welding
Solenoid Accelerator Controller	Readymade
Assembling	n/a
Test Vehicle	n/a



Table 2: Manufacturing Processes

Result & Discussion:

As per the results we got and after doing uncertainty analysis, we found that:

- 1) Test run no. 1 and 2 were failure because of fabrication errors and mechanical failures.
- 2) Test run no. 3 and 4 were having quit promising results.
- 3) Test run no. 5 was with traffic and motor drained huge amount of air in initial accelerations.
- 4) Test run no. 6,7 and 8 were considered actual tests while calculating time required for full drain of full 150 bar pressurized air storage.
- 5) Test result shows air consumption of 0.4 m³/min which is very near to theoretical air consumption 0.39m³/min. This validates our testing considerations and parameters taken while testing. Initial accelerations requires 8 bar pressure at inlet of motor which is increasing consumption. While at idling and crusting speed this pressure decreases to 5 to 6 bars only. Many areas are prone to leak air at high pressure. This are must be areas taken into high priority considerations.



Fig 4: Final Test Run

RESULTS	DATE (dd/mm/yyyy)	TANK PRESSURE AT START (bar)	TANK PRESSURE AT END (bar)	TIME OF RUN (hh:min)	DURATION (min)	TOTAL DISTANCE TRAVELLED (km)	TOP SPEED (km/h)	TRAFFIC DENSITY	REMARKS
TEST RUN 1	01/05/15	150	100	12:15 pm	2	0.5	0	low	Technical Failures
TEST RUN 2	03/05/15	100	30	4:30 pm	3	0.8	0	low	Technical Failures
TEST RUN 3	06/05/15	150	0	10:30 am	9	5.3	23	medium	-
TEST RUN 4	07/05/15	150	0	2:00 pm	12	9.2	31	medium	-
TEST RUN 5	08/05/15	150	0	9:00 pm	7	3.6	15	high	-
TEST RUN 6	09/05/15	150	0	1:15 am	14	11.2	43	very low	-
TEST RUN 7	10/05/15	150	0	11:00 pm	14.5	11.4	47	very low	-
TEST RUN 8	11/05/15	100	0	7:00 am	10	8.1	48	very low	-

CONCLUSION:

At the completion of the project we concluded that:-

1. One full tank can serve up to 15km after optimization.
2. Including maintenance charges and refueling charge of tank, it takes Rs.1.75 per km which is very low compared to conventional I.C. Engines.
3. Maintenance of the system is very negligible compared to conventional I.C. Engines.
4. With the help of testing parameters we can say that by using specialized compressed air storage tank with 350 bar, vehicle can run up to 30-35km which is very promising result in finding alternate to conventional I.C. Engine. One can manage 2-3 storage tanks to increase the next fueling time up to 70-100km.
5. No pollution air engine is proved to give initial torque and similar properties to I.C. Engine.

6. Cost of this system is extremely low when compared with Electrical Vehicles, Conventional I.C.Engines and other Hybrid Systems. This system is cleaner than hydraulic systems. Because of previous mentioned conclusions, we can say that air engines are one of the best alternate to conventional internal combustion engines and can shape the future in a green and clean way.

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