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Exhaust Pressure Emitted from Vehicle to be used for Air Conditioning Purpose

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Abstract—*An Automobile engine is crucial when considering about the power consumption and cost of the automobile. Nevertheless, traditional air conditional system consumes 5% of the total energy of vehicle and it has resulted in lower life span and higher fuel consumption. Though various inventions were brought to the automobile industry time to time, it can be seen various drawbacks and weaknesses in the existing air conditioning systems. Accordingly, this research is based on introducing an automated way to improve the fuel consumption of vehicle, increase engine power and using waste part from the vehicle.*

Keywords*: Automobile, Air Condition, Compressor.*

Introduction

Automobile technology has searched alternate vehicle technologies due to various reasons. An automobile engine using only 35% of available energy and rest are lost to cooling and exhaust system. Usually vehicle air condition system utilizes 5% of the total energy. Therefore, automobiles become costlier, it's less efficient and uneconomical.

On the other hand, motor vehicle emission has become a major pollution to air and major ingredient in creation of smog in certain large cities. Accordingly, concentration has been extended to develop mission control sensors on both diesel and petrol vehicles. In Automobile application mainly used air condition system is driven by belt, so this gets engine output from crank pulley, the whole which gets from crank pulley gives to air condition compressor, vehicle power steering system and water pump etc. but main target is to use as useful work on waste exhaust pressure in a vehicle. Nowadays this air condition system gets more advance & raising with more technology. In an electronic powered vehicle, hybrid technology vehicle etc. But cannot improve this waste exhaust on these advance vehicles. Therefore, used this method to normal petrol engine four-cylinder car for an experiment. And mainly use with diesel vehicles because that needs more power & it's getting more exhaust pressure from exhaust line than petrol engines.

Up to present various efforts have been undertaken to reduce such power consumption as explained above. In 1820, Michal Faraday discovered the compressed and liquefies ammonia. In 1881, navel engineers built a boxy makeshift cooling unit & kept them as cool with comfortable. Thereafter many engineers came up with various type of Air condition systems, which have been used in the automobile industry. Nevertheless, still there are certain drawbacks such as extra power consumption, environmental pollution and higher cost in the air conditioning system which have been used up to now. Accordingly, it is expected to develop a solution which could address above drawbacks and issues.

Proposed solution

In modern technology, there are many ways to collect exhaust power & energy on vehicles. Accordingly, it was expected to design a simple system, running together with engine power for air conditioner system. The objectives of the proposed system are to improve the fuel consumption of vehicle, increase engine power and using waste part from the vehicle. This design will get simple extra units as low cost and to use waste of exhaust that could help to get power from this exhaust pressure & mainly can reduce fuel wastage with preforming engine exhaust pressure for using back again. Engine power will be increased from this system.

Approach and methodology

Design A- Air Condition from Vehicle Exhaust Pressure (System 1)

The main aim of this project is Using exhaust pressure and produce Air condition with rotating Air condition compressor. By using exhaust pipe of a vehicle, it can be obtained exhaust pressure and its using for rotate turbine of a turbo system and such rotation gives to the power to turbo compressor while the compressor gives the power for air condition compressor. Therefore, centrifugal clutch is used for the air condition Compressor to give air to condition Compressor. Being

vehicle exhaust pressure is not enough to rotate Air condition compressor completely, the power can be joined with engine power to air condition compressor.

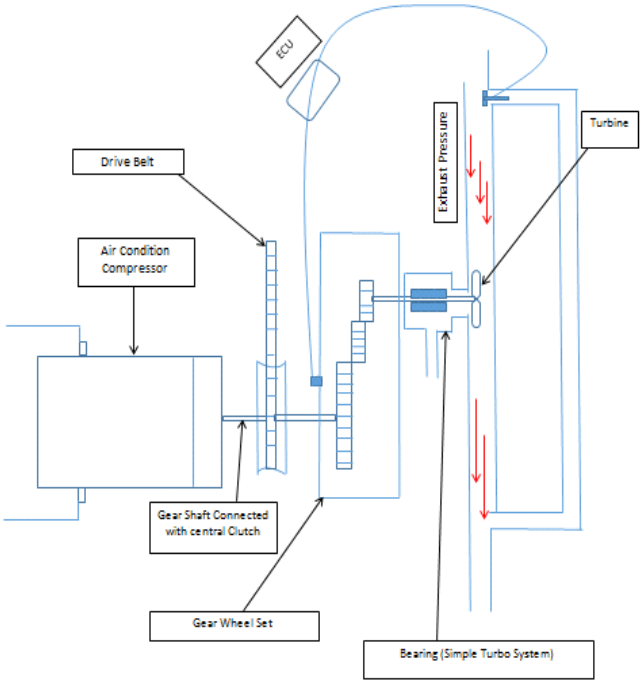

Fig. 3-1: Air Condition from Vehicle Exhaust Pressure

Design B- Vapor Absorption Refrigeration System (System 2)

The vapor absorption refrigeration system is mainly standing of all the processes in the vapor compression refrigeration system with compression, condensation, expansion and evaporation. In this absorption system the refrigerant using ammonia, water or lithium bromide. The refrigerant gets condensed to the condenser and it gets evaporated to the evaporator. The refrigerant creating cooling effect in the evaporator and releases the heat to the atmosphere via the condenser.

The major differences of these two systems are the method of the suction and compression of the refrigerant in the refrigeration cycle. In the vapor compression system, the compressor sucks the refrigerant from evaporator and compresses it with high pressure. The compressor also enables the flow of the refrigerant through the whole refrigeration cycle. In the vapor absorption cycle, the process of suction and compression are carried out by two different devices called as the generator and the absorber. On the other hand, the method of inputting energy to the system also different in two systems. In the vapor compression system, the Energy input is given in the form of the mechanical work from the electric motor run by the Electricity whereas heat is the way that gives from the vapor absorption.

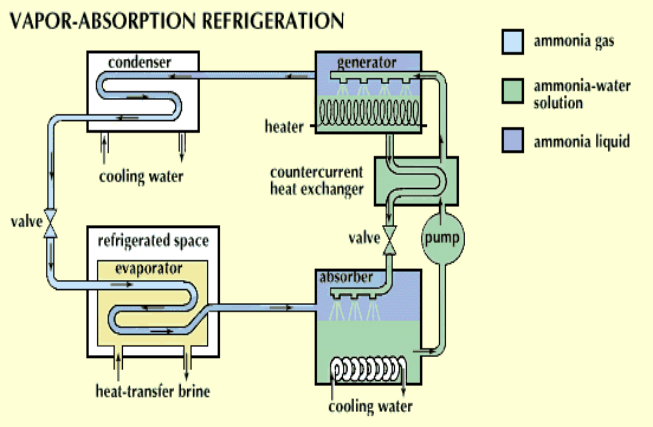

Fig. 3-2: Vapor Absorption Refrigeration System

Design C- Creating Electricity with Exhaust Gas (System 3)

There is a system for creating electricity with using exhaust gas which was created by Mr. Visteon and it is called as TIGERS (Turbo-generator Integrated Gas Energy Recovery System). It uses the exhaust gas from a car's combustion engine to create electricity which is enough to power the vehicle's electrical system, thus taking a load off the engine. This technology could be coupled with hybrid technology and the extra electricity and it could help to recharge the hybrid's batteries. But this system should be more advantage in near future.

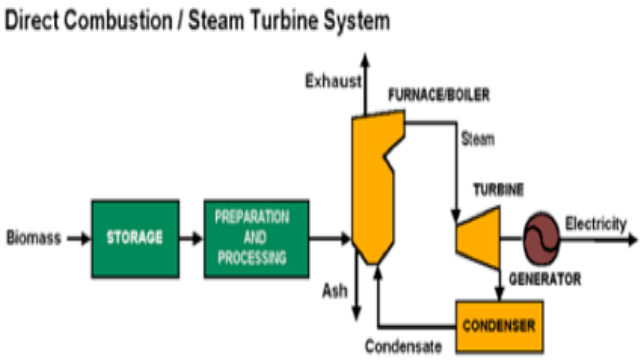

Fig. 3-3: Simple design of generating electricity from exhaust

Selecting criteria

Below are the criteria that are considered in selecting a project.

	System 1	System 2	System 3
Reliability (% of faults)	8	4	8
Human Operated	1	1	7
Cost	5	6	6
Durability	5	9	3

	Reliability	Human Operated	Cost	Durability	
Reliability	-	0.5	0.25	0.5	**0.75**
Human Operated	0.5	-	0.75	0.25	**1.5**
Cost	0	0	-	0.25	**0.25**
Durability	0	0.5	0.25	-	**0.75**

	Minimum	Maximum
Reliability	0	10
Human Operated	1	7
Cost	5	6
Durability	3	9

	System 1	System 2	System 3
Reliability	20	60	20
Human Operated	90	90	30
Cost	50	40	40
Durability	50	10	70

	Weight	System 1		System 2		System 3	
		Score	W.S	Score	W.S	Score	W.S
Reliability	2.30	20	46	60	138	20	46
Human Operated	4.61	90	414.9	90	414.9	30	138.3
Cost	0.76	50	37.5	40	30	40	30
Durability	2.30	50	115	10	23	70	161
	9.96		**613.4**		**605.9**		**375.3**

Accordingly, system 1 (Design A) gets the first highest rate and it was considered in further development.

Turbo System

Turbocharger is a special type of supercharger in which a gas turbine is used to raise the pressure of air fuel mixture that is to be supplied to engine and it is powered with kinetic energy of exhaust gas pressure from the engine. The compressor is operated when the turbine rotates. When the engine reaches a certain speed or RPM, the clutch activates, working somewhat like a continuously variable transmission. As the load increases, the speed drops, disengaging the clutch, letting the speed rise again and reengaging the clutch. If tuned properly, the clutch will tend to keep the speed at or near the torque peak of the engine. It has been used this advantages for designing of system. This results in a fair bit of waste heat, but over a broad range of speeds it is much more useful than a direct drive in many applications.

Fig. 3.4. Turbo System

Air Condition Compressor

This is like system in refrigerator and moves liquid refrigerant around in a pipe. It could be two-cylinder reciprocating piston type, four-cylinder radial type or six-cylinder axial type. The air condition compressor compresses the refrigerant, and rises its temperature higher than the surrounding air. Then the compressor forces the refrigerant in to the air condition condenser.

This has an electromagnetic clutch which can engage and disengage the compressor pulley.

Fig. 3.5: Air Condition Compressor

Air Condition Compressor Drive Ring

There is a drive ring made of frictional material that can be mount to both side of swash and wobble plate. These plates rotate for the frictional material pushes from the ball bearings back and forth. This is also functioning inside of air conditioners refrigerant compressor.

Gears (Helical Gear Wheels)

This is like the concept in Turbo system, but replaces the turbo compressor wheel with gear wheels. A cogwheel or gear is the moving as rotating part which having cut teeth or cogs with meshing one and other toothed to part transmit of torque. The most of cases with teeth on one gear is being of impartial shape. And often it's also with that shape on the other gears. Gear train is called when the two or more gears are working together.

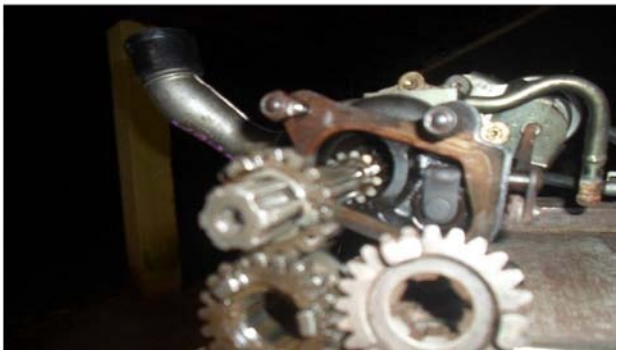

Fig. 3.6: Gears (Helical Gear Wheels)

Centrifugal clutch

This is a clutch that uses centrifugal force to connect two shafts, with the driving shaft inside the driven shaft. It engages more at higher RPM & Speeds.

Usually the input of the clutch is connected to the engine crankshaft while the output may drive a shaft, chain, or belt. As RPM increase, weighted arms in the clutch swing outward and force the clutch to engage.

Fig. 3.7: Centrifugal clutch

Results and discussion

The Turbine transfer power to design gear wheel if fractional losses are not applicable. Three gear wheels were selected for transmitting the power & torque of Exhaust to Air condition compressor.

1st wheel D1=0.04m with 40 teethes

2nd wheel D2=0.08m with 80 teethes

3rd wheel D3=0.15m with 150 teethes

This air condition compressor can rotate around 1000rpm to 4000rpm while Turbine rotates 217824.29934rpm. When the engine is rotating 6000rpm with 109Nm torque, Turbine speed is 217824.29934rpm and power output is 2486.47kW. On the other hand, when the engine rotates 4000rpm, the Torque will calculate 194.03Nm and Turbine speed is 217824.29934rpm.

Calculations for Centrifugal clutch

Assuming the Centre of shoe lies at distance 5mm less than R, Force Excreted by Spring Ps is 167.0337Nm and Centrifugal force acting on each shoe is 120252.1125N.

Cost analysis

Component	Quantity	Cost (USD)
Turbo Unit (Used)	1	520.52
Gear Wheels (Helical)	3	450
Centrifugal Clutch	1	250.80
Centrifugal Clutch Accessories	2	180
Gear Shaft	2	130.50
Driving sprocket	2	50.1
A/C Compressor Pulley Cover	1	348
Other Accessories		150
Total component cost		2079.92

Total component cost	=	USD 2079.92
Total manufacturing and assembling labour cost	=	USD 850
Tooling cost	=	USD 200
Total electrical wiring cost including labour and other accessory cost	=	USD 120
Total cost	=	**USD 3249.92**

Accoridngly the total cost of developing the system would be USD 3249.92.

Material selection

Many type of springs available for many purposes. Axial springs (a rubber band), helical springs, leaf springs, spiral springs, torsion bars etc. Regardless of their shape or use, which can store the greatest elastic potential energy per unit mass or volume that is the best material for a spring a spring. Such spring is used to store elastic energy and releasing it again when required.

Depend limit-σe, with replacing the modulus of rupture σmax. Springs should more efficient on high temperature. Strength at temperature is needed. The mechanical loss coefficient is important in springs which are loaded dynamically. To provide a corrosion barrier the least expensive solutions to this problem is to plate or polymer-coat, but when the coating is damaged, failure can increase. The more expensive solution is to make the spring from a volubility of corrosion-resistant material. After considering pros and cons of each alternative material it was decided to use GFRP for the centrifugal clutch springs.

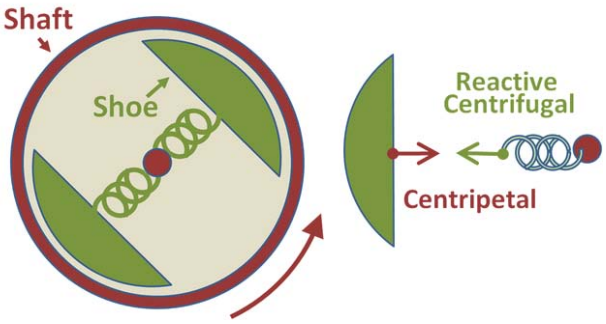

Fig.3.8. Centrifugal clutch springs

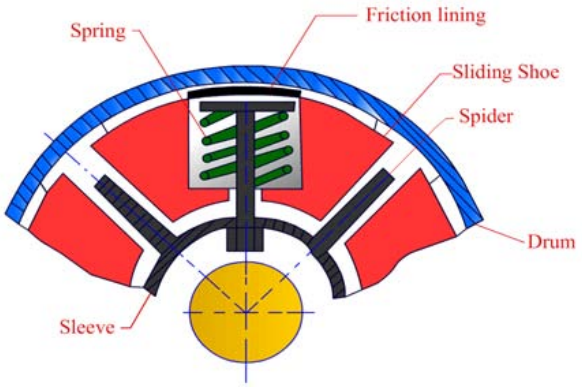

Fig. 3.9. Basic functioning system of centrifugal clutch

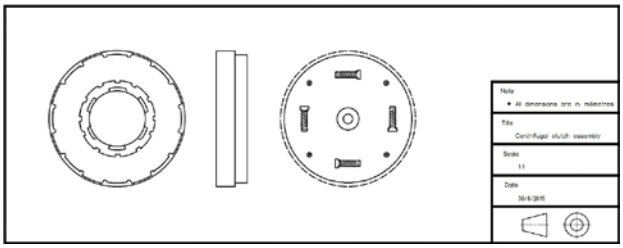

Fig. 3.10. Layout drawing of centrifugal clutch

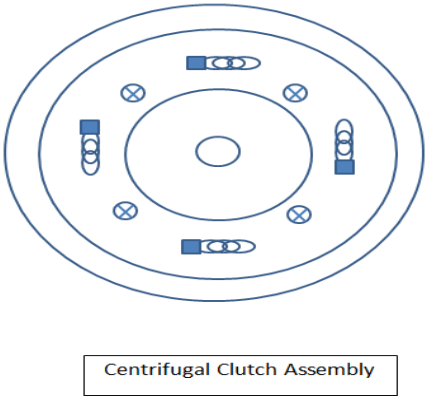

Fig. 3.11. Centrifugal clutch assembly

Conclusion

When 912.422 rpm centrifugal clutch rotates with 164.2119N of power, therefore Increasing of engine rpm centrifugal clutch rotating force can be increased. With this system engine pulling power mainly connects with exhaust output power. Therefore, it can be simply gained simply gain some fuel consumption with this method. & the main target of the theory. This system more efficiently run with metal parts therefore these parts should lower weight & Simple because this can be effect to the fuel consumption.

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