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Research Article

In-Built Coolant Cooling System

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Abstract

The objective of this paper is to present the new technologies, innovations and trends in the area of automobile cooling and automobile air conditioning and cooling system, which is fast and very effective. The advancement in the field of aerodynamics and the engine management system has made the modern vehicles and automobile much faster as compare to the vehicles and automobiles of previous generations. In the modern era, the engine size is comparatively smaller and advanced for reaching the higher speed and torque requirement. As the engines of the new era become advanced, the speed and the power generation and the torque production are also high. And due to the higher power generation and the speed accessibility, the temperature of the engine becomes very high. It is increased when engine is in the running state. It creates many problems in the engine and can be dangerous for vehicle. For conquering this problem a cooling system is installed in our vehicles called Radiator which cools engine (working on the previous cooling management system) but as the above description said the advancements are done as the new generation comes. So we have to require the advanced cooling system and devices for better performance of the engine as well as the vehicle.

Keywords: Engine Cooling, Air Conditioning, Advanced Radiator System, Performance, Efficiency

Introduction

In the modern era, everybody wants new technology and innovations and specifications by which life can become easier and faster. So in the automobile sector, the demand of powerful engines is increasing day by day. As the power of the engine increasing its speed and temperature is also increasing. The problem of rising temperature is doubled in the season of summer. The rise in temperature of the engine has created a problem of insufficient rates of heat dissipiation in the automotive radiators. Generally the 33% of the energy generated by engine through combustion is lost in the heat. The generated heat in the engine can cause overheating in the engine which results in breakdown of lubricating oil, coolant boiling which can cause the radiator to explode, piston swelling as well as the metal weakening of engine parts , it can wrapped the cylinder heads and cracked the head gasket , it also melts, cracks or dry out the seals which can cause leaks . to minimize or for solving this problem , the advanced radiator system and cooling device should be launch in the automotive sector for better efficiency, performance and life of the engine. The conditioning in the radiators also helps to clean the air in the cab by removing dust, pollen, smoke or moisture. The different factors are influencing in the functions of radiator. Radiator incorporated with atmosphere air, flow of the coolant present in the system, density of the cooling fins as well as temperature of the air intake into the system. It is identified that when the atmospheric air and the mass flow rate of the coolant raising the cooling capacity of the radiator be increases. In this research work a new radiator is formed after analyzing the existing radiators which can cool more efficiently and effectively as compare to existing radiator

Conventional Cooling System in I.C. Engines

These are the some basic types of engine cooling system which is conventional and based on previous formations and designs. As we know that, in the internal combustion engines, Combustion of air and fuel takes place inside the piston cylinder and hot gases are generated inside an

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internal combustion engine. Such gases are $so_{2,}$ no_2,co_2, harmful, vapours etc. Engine produces high amount of heat while running. This can raise the engine temperature to very high level and can damage or seize the engine components. The temperature of gases may rise up to around 2300-2500°C, which is a very high temperature and may result into burning of oil film between the moving parts, pre combustion and may result into seizing or welding of the moving parts. This can also led in the expansion of the metallic parts and can boil the coolant which may blow a hole in the side of the hose or cause the radiator to explode. So, this temperature must be reduced to lower values at which the engine will work properly and much more efficiently. Too much cooling is also not desirable since it reduces the thermal efficiency and reduces the vaporization of fuel thereby showing improper burning in form of black smoke in exhaust. Though the conventional engine cooling system which is either air cooled or water cooled are designed to remove about 30-35% of total heat that the engine dissipates. The conventional cooling system needs some advancement:-

- The radiators fitted in current engine cooling system are limited by air side resistance and require a large frontal area to meet cooling needs.
- Current engine cooling system has limited heat dissipation and does not meet the requirement at high engine output.
- Heat dissipation to volume ratio of the system is less.
- At high speeds it is difficult to maintain the temperature of engine components.
- Heat rejected by the system (about 35%of heat generated) is wasted to the atmosphere.

Conventional Radiator, Cooling System In Automobile

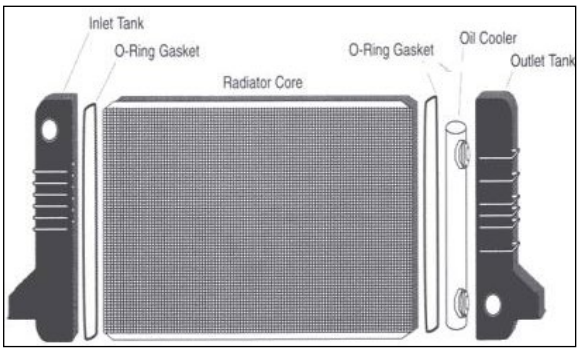

Figure 1.Conventional Radiator of Automobile

Components of conventional radiator system

Heater Core: A typical heater core is designed and constructed very much like a miniature engine cooling radiator. It features inlet and outlet tanks connected by headers to a heat exchanger core. The heater core tank, tubes, and fins can become clogged over time by rust, scale, and mineral deposits circulated by the coolant.

Water pump: The water pump is attached to the engine block. Its main purpose is to keep the coolant circulating. It draws cooled coolant in form the lower radiator hose and pushes it through the engine

Thermostat: The thermostat is the brain of the cooling system. It senses the temperature of the coolant and allows the fluid to exit the radiator. The thermostat controls the temperature of the coolant and allows the fluid to exit to the radiator. The thermostats are rated at specified temperature usually- between 250 to 260 degrees Celsius. . A malfunctioning thermostat can cause the engine to overheat or not reach normal operating temperature, and either of these conditions will impact the cab heater performance.

Hoses (upper and lower hose): There are several rubber hoses that make up the plumbing to connect the components of the cooling system. The main hoses are called the upper and lower radiator hoses. These two hoses are approximately 2 inches in diameter and direct coolant between the engine and the radiator. These hoses are designed to withstand the pressure inside the cooling system. Because of this, they are subject to wear and tear and eventually may require replacing as part of routine maintenance.

Radiator Fan: Radiator fans are Mounted on the back of the radiator on the side closest to the engine is one or two electric fans inside a housing that is designed to protect fingers and to direct the air flow. These fans are used to keep the air flow going through the radiator while the vehicle is going slow or is stopped with the engine running. If these fans stopped working, every time you came to a stop, the engine temperature would begin rising.

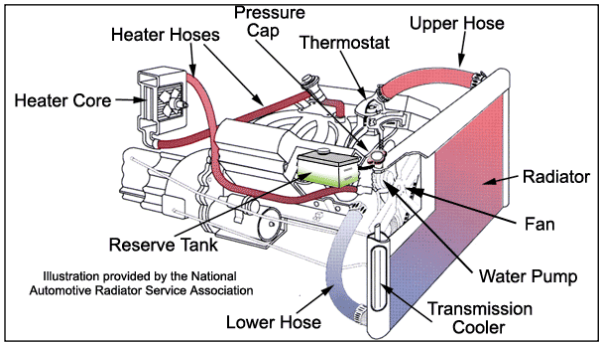

Figure 2.Radiator Cooling System in Automobile (Isometric View)

The Radiator: The radiator core is usually made of flattened aluminum tubes with aluminum strips that zigzag between the tubes. These fins transfer the heat in the tubes into the air stream to be carried away from the vehicle. On each end of the radiator core is a tank, usually made of plastic that covers the ends of the radiator, another component in the radiator for vehicles with an automatic transmission is a separate tank mounted inside one of the tanks. Fittings

connect this inner tank through steel tubes to the automatic transmission. Transmission fluid is piped through this tank inside a tank to be cooled by the coolant flowing past it before returning the transmission.

Radiator Cap: Th,e radiator pressure cap is a simple device that will maintain pressure in the cooling system up to a certain point. If the pressure builds up higher than the set pressure point, there is a spring loaded valve, calibrated to the correct pound per square inch, to release the pressure.

Introduction to Advanced Radiator Conditioning System

As my research work taught about the basic and conventional radiators and cooling system in the upper description. It seems that, the modern as well as the future generation requires the more and efficient cooling. As my research work describes that as the time reaching to the new generations the demand of more powerful I.C. engine increases with the higher speed as well as the higher efficiency and averages. We can increase the efficiency of automotive vehicle by modification in the frame work or its structure but we cannot increase its efficiency as much as we want. So this method is not applicable for our requirement. As my research work describe that the new generation want powerful engines with higher speed and performance but for increasing the speed , our engine have to work more and more and in this whole procedure the combustion rate in the engine is high, this led to the rise in temperature of the to the up to the greater levels and as the speed increases the temperature is also increases, so for conquering this problem "The Advanced Radiator Conditioning System" is introduced by me and my research work to the modern era which can cools faster and efficiently as compare to the conventional cooling system or the basic engine cooling system. It is basically the modification of the conventional cooling system made by modifying the older design and addition of new refrigerating system which is called my coolant conditioning unit (CCU). This whole coolant conditioning system works faster and efficient and the most valuable thing is that it can increase the efficiency of the vehicle with higher cooling than that of conventional cooling system.

Components of the Advanced Radiator Conditioning System:

- Thermostat
- Heater core
- Lower hose
- Upper hose
- Pressure cap
- Common radiator or blower
- Radiator cap
- The radiator
- Coolant Cooling Unit(CU)
- Turbo charging Dynamo(TCD)
- Water pump
- Modified Radiator(MR)

As my research work describe the basic cooling system components like thermostat , heater core, lower hose, upper hose, pressure cap, radiator cap and the radiator in the other description, but the main modifications are done by adding common evaporator or blower ,coolant cooling unit (CU)and turbo charging dynamo(TCD), Modified Radiator(MR).

Introduction To Coolant Conditioning Unit(CCU)

The advanced radiator conditioning system consist of two units first is our basic conventional cooling system and the second unit is my CCU (Coolant Conditioning Unit), they both are combined to form "The Advanced Radiator Conditioning System" Basically, the CCU consists of coolant cooling unit (CU), turbo charging dynamo (TCD), Modified Radiator (MR), common radiator.

Modified Radiator(MR): In the modified radiator, the fins of the radiator can be made up of carbon instead of making it from aluminum (which is found in the current radiator design) by which more heat dissipiation can be obtained. Because carbon foam can increases the surface area exposed to the air. This is mainly due to the fact that the carbon foam is porous and allows the air to flow through it in addition to allowing the air to flow around it. By which hot air can easily outlet from our cooling system.

Turbo charging dynamo(TCD): as the name describes it, it seems like a turbocharger which exceeds the flow of air into the inlet valves of the engine by the help of flow of the outlet exhaust gases but there is a small difference between turbocharger and turbo charging dynamo is that in the place of air exceeding turbine in the turbocharger, a dynamo is fixed or fitted which can generate the power in the form of electricity by which we can able to run our "coolant cooling unit(CU)" So by this formation of mine and my research work ,we can easily generate the power. As the flow of exhaust gases increases, the power generation is also increase then my CU gets more power which results in the faster cooling by which we can get higher efficiency, long life, and better performance of our vehicle. So basically by this formation of my research work is depend upon the flow rate of exhaust gases in the TCD (Turbo Charging Dynamo).

Coolant Cooling Unit (CU): My coolant cooling unit (CU) is based on the one of the basic principle of air-conditioning. It is just like the heart of my "coolant conditioning unit (CCU)". Now the question is arise why i am choosing this system because it only consist air to be compressed and we know that the density of air is minimum and less than that any of the refrigerant s in the liquid cooling system.

So this is the best option for me and it cannot cause the several leaks as compare to the liquid cooling system. This unit is just similar than the air-conditioning system but it is also different from the air conditioning system. It is based on the some basic thermodynamic principles to produce more comfortable climate with in an enclosed area.

Working of the coolant cooling unit (CU): As my research work described that it is based on the some basic thermodynamic principles. As the air reaches from air source to the compressor zone, it is compressed by the compressor where its pressure increases, temperature increases but volume decreases. Now hot compressed air (high temperature air) reaches to the common radiator which is common to my coolant cooling unit(CU) as well as conventional cooling system , this common radiator works as condenser to my coolant cooling unit(CU). After passing through the compressor its temperature decreases (volume same, pressure same) and the air become much cooler than that of the air which we taken from our air source. Now that cooled air is passes through the expansion valve, where the expansion is done by which its pressure as well as temperature decreases .so now our air is much cooler than that of air which is outlasted from the common radiator. Now in the last our air become much more cooler which can be Serves as the coolant cooling refrigerant for our coolant which is flow in the conventional cooling system.

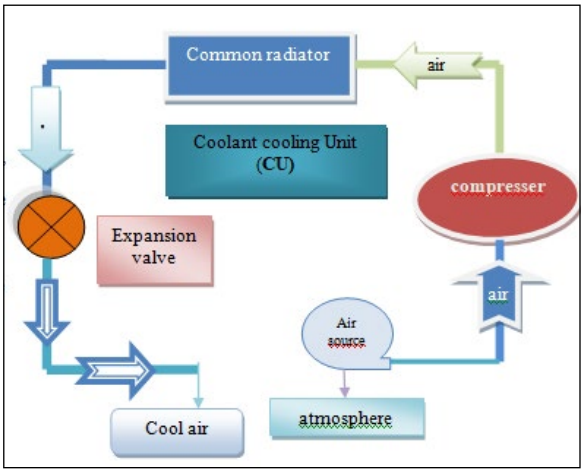

Figure 3.Block diagram of Coolant Cooling Unit (CU)

Now the thing is that how can I run compressor so the answer is the compressor is run by the power which is generated by the Turbo Charging Dynamo (TCD). Now our air is enough cooled for conditioning the coolant flow in the conventional cooling system. This is the whole working of my "Coolant Cooling Unit (CU)".

Common Radiator: our modified radiator is worked as the common radiator between the conventional cooling system and coolant conditioning unit due to its modification it can work commonly to conventional radiator cooling system and coolant conditioning unit. It required a different description of understanding easily. So, I had given a different description for it.

Analysis of Advanced Radiator Conditioning System

For the analysis of advanced radiator conditioning system we have to assume the values of some quantities for the conventional radiator system.

These are the some quanties which are assumed for specify condition for conventional radiator system.

Assumed the radiator size is 0.5 X 0.5 meters so the area will be 0.25m^2 and let us assume the velocity of the air is 40km/hr . . . . so the calculations are

Radiator size = 0.5 m X 0.5 m
Area =0.25 m^2
Velocity = 40 km/hr.
⇨ 11.11 m/sec

So, volume flow rate by Bernoulli equation

$$Q=AXV$$

Here, Q is volume flow rate
A is area of radiator
V is velocity of air

So, Q = 0.25 X 11.11
Q = 2.7775 m^3 per second

So, Mass flow rate
m = density X volume flow rate
m = ρ X Q

here, ρ is the density of air which is 1.25 kg/m^3

so, m = 1.25 X 2.7775
m = 3.4718 kg/sec

now, if 1 kg air is required to cool 1 degree Celsius in 1 second of time then 3. 4718 kg air is required to cool 3.4718 degrees Celsius temperature in 1 second so, in 1 minute it can cool = 3.4718 X 60
= 208.308 degrees
So, if the conventional radiator system can cool 208 degrees Celsius in 1 minute then it is assumed and considers that advanced radiator conditioning system can cool up to 312 degrees in 1 minute of time more effectively and efficiently.

Comparison between Conventional Cooling System and Advanced Radiator Conditioning System

As we understand by my research work that the advanced radiator conditioning system is more effective, efficient and faster than the conventional cooling system. It has the more temperature limit than that of conventional cooling system it means that advanced radiator conditioning system can

cool the engine at higher temperature s efficiently and faster than that of conventional cooling system. As my assumed analysis in the upper description confirm that for assumed design and data, it is observed that if the conventional cooling system decrease 208 degrees Celsius in 1 minutes then the advanced radiator conditioning system can cool the whole engine system and decrease the temperature to 312 degrees Celsius in one minute. So it is conclude that the 50% additional temperature decrement is observed in the system by the addition of coolant conditioning unit (CCU). So if the conventional cooling system cools the engine system by 60% then my advanced radiator conditioning system can cool it by 90% with faster and efficient cooling.

Conclusion

It is conclude that the advanced radiator conditioning system is successfully developed. It can be more efficient, faster and ecofriendly. As my research work describes that the new generations wants new powerful engines of high speed and efficiency and as the speed increases, the temperature of those powerful engines got higher which cannot maintain and cool by conventional cooling system, so as the demand for those powerful engines, me and my research work proposed the idea as well as future application of advanced radiator conditioning system which can cool those powerful engines faster and efficiently. This can able to perform automotive vehicles effectively even in bad circumstances. The main objective of the research is to propose advance and effective cooling system that able to control and maintain temperature inside automotive vehicle faster,smarter,effectively as well as efficiently

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