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## **MODIFIED AIR FILTER USING GUN METAL AND ALUMINIUM MESH IN DIESEL ENGINE –A REVIEW**

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### **ABSTRACT**

Diesel engines use compression ignition, a process by which fuel is injected after the air is compressed in the combustion chamber causing the fuel to self-ignite. By contrast, a gasoline engine utilizes the Otto cycle, in which fuel and air are mixed before ignition is initiated by a spark plug. Most diesel engines have large pistons, therefore drawing more air and fuel which results in a bigger and more powerful combustion. This is effective in large vehicles such as trucks, diesel locomotives. The combustion in diesel engine takes place with the help of fuel & air. So the intake air needs to be free from all sort of impurities. This work is effectively done by air filter in it. The basic and the most important function of the project are to improve the quality of air using the concept of Ionization. Thus using the Electronic Air Cleaner to ionize (electrically charge) air molecules i.e to attract oppositely charged (positive charge) airborne impurities towards it. As a result the dust particles get stuck to it and the air free from impurities passes further and thus reduces the early clogging of filter. Finally the diesel knocking and vibrations will decrease to minimum level. Some of the parameters which is tested is that decrease in fuel consumption keeping the same amount of brake power, increment in mechanical efficiency by 4%.

### **I. INTRODUCTION**

This research work is carried out to modify the existing air filter for better quality of intake air & thereby increasing the performance of the diesel engine. Diesel engines in today's world are used in many fields. Basically diesel engines work on diesel cycles in which fuel and air required for combustion are compressed separately and brought together at the time of combustion. In such arrangements fuel can be injected to cylinder which contains air at a higher temperature than the self-ignition temperature of the fuel. Such engines work on heavy liquid fuels.

Air filters are primarily used in heating, ventilation, and air-conditioning (HVAC) systems to remove from the airstream those particulates that can cause fouling of the heat-transfer surfaces. However, the reduction of the amount of particulates in occupied areas is becoming an increasingly important concern for all air-filtration systems. The inexpensive, common, throwaway filter (which is suitable for the majority of applications) is designed to remove large-size particles. The removal of smaller-size particles, however, requires a more-efficient or special purpose filter. For military housing, the optimum schedule was to replace the filter monthly; there was, however, only a slight difference in the cost savings from this schedule when compared with the other schedules examined. Although the energy cost savings are slight, filter replacement is an important part of any preventive maintenance program. Also, an operating condition that can lead to a premature compressor failure was identified: clogged filter combined with a high outdoor temperature, beginning at about 105°F, for units having a capillary tube as the expansion device. Regular filter replacement can contribute to a longer life for compressor and motors and can be very cost-effective if early failure is prevented. Further, the filters should be replaced before they become clogged and dirt begins to accumulate on the evaporator coils.

#### **Air Filter:**

This research is concentrated on Electronic Air Cleaner. Electronic air cleaner is an ionizer which creates negative ions. It is an electrical and electronic device designed to filter the air from 0.01 micron to 50 micron size. A disposable air filter in heating or working system traps less than 10% of the particles of air pollution passing through it. Electronic air-cleaner will collect up to 99% of pollen, dust, smoke, ash in your factories, power plant or coal mines etc.

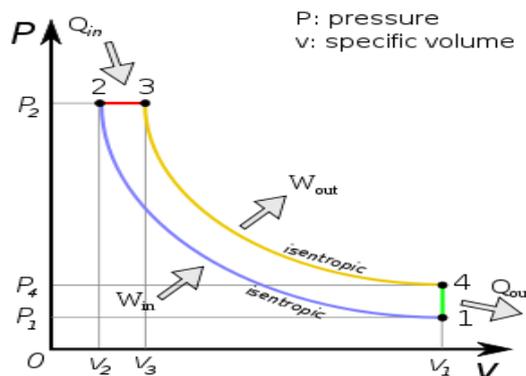
The electrical separator's work in power plant is to trap the large ash particles by means of the negative plate or metal mesh pre-filter. The remaining particles, some as small as 0.01 microns, pass into a strong electrical field (ionizing section) where the particulate receives an electrical charge. The charged particles then pass into a collector plate section made up of a series of equally spaced parallel plates. Each alternate plate is charged with the same polarity as the particles, which repel, while the interleaving plates are grounded, which attract and collect the contaminants. The contaminants are held in these plates until they are removed by force conventionally (with the help of fan) to the surrounding atmosphere. This same concept we used in proposed device i.e. modified air filter to purify the air and pass the dry clean air to the combustion chamber in diesel engine so that maintenance of engine is reduced and engine yields a good performance.

• **Objective**

- 1) Modification of air filters for better quality of intake air and thereby increasing engine overall performance.
2. To enable cold starting by the use of warm up coil.
3. To increase the oxygen content for enhancing the combustion process by reducing or the dust particles, charged particles bacteria's etc.
4. To increase the quantity of air sucked by providing fan when climbing up in hilly regions.

• **Diesel cycle**

The Diesel cycle is the thermodynamic cycle which approximates the pressure and volume of the combustion chamber of the Diesel engine. The figure shows a P-v diagram for the ideal diesel cycle; where P is pressure and v is specific volume.



- Process 1 to 2 is isentropic compression (blue)
- Process 2 to 3 is reversible constant pressure heating (red)
- Process 3 to 4 is isentropic expansion (yellow)
- Process 4 to 1 is reversible constant volume cooling (green)

• **Symptoms of Clogged Air Filter**

If air doesn't pass through, then it is a sign of a clogged air filter. It signifies that the air filter needs to be replaced. Some of the other symptoms are

- **Starting Problem:** Trouble in starting the engine is the most common situation faced by car owners. A problem with the air filter leads to starting issues. If the engine does not start at all, it is a sign that the fuel filter is totally clogged. If the engine takes too long to start, then it is a sign that the air filter is partially blocked.
- **Engine Stoppage:** You are at a signal, your vehicle stops and refuse to start. If you are navigating through steep slopes, the engine behaves as though you are running out of gas and eventually stops abruptly. If this is a regular feature with your vehicle, it means that the engine is not getting adequate supply of fuel. Insufficient fuel supply causes the engine to stall; air filter clogging can lead to insufficient fuel supply.
- **Problem in Accelerating:** If inspite of stepping on the gas, the speed of the vehicle is the same (no acceleration), then it is a clear sign of a clogged air filter.
- **Engine Performance Issue:** If you realize that your engine is no more fuel efficient and is also behaving erratically, its time to clean or replace your air filter.

- **Engine Misfiring:** If the sound of your vehicle engine has changed and it is misfiring, a clogged air filter could be the reason behind the same. Very often it just needs good cleaning up.
- **Exhaust Fume Odor :** Sometime the car exhausts foul smelling fumes. Such fumes means that the air filter needs replacement.

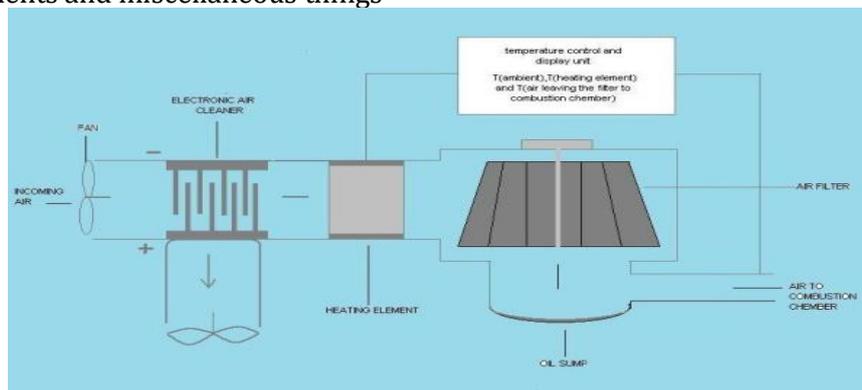
### Advanced Air Filter for Diesel Engine

By advanced air filter we don't mean to change the whole filter we are just making some changes in the existing air filter. This project is aimed at modification of air filters for better quality of intake air and thereby increasing engine performance. As air filter filters the engine's necessary air (oxygen) so the combustion process is greatly influenced by the efficiency and arrestance of the air filter being used.

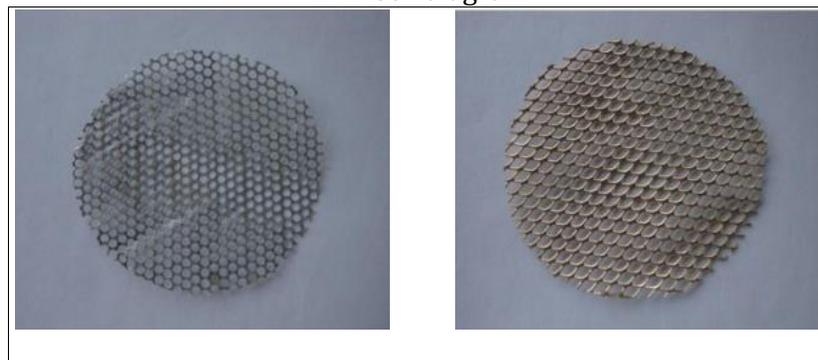
- **Physical construction**

The advanced air filter is basically a filtration device with certain additional features which will definitely affect the combustion process in a positive way. The advanced air filter will contain

1. An electronic air cleaner.
2. A heating element to raise intake air temp.
3. A highly viscous oil sump.
4. A basic air filter.
5. Temperature Sensors
6. Two Fans i.e. one suction and the other exhaust
7. Electronic components and miscellaneous things



1. Block diagram



2. Gun Metal & Aluminium mesh

- **Construction & Working**

As we can see in the given diagram the external air first comes in contact with the first filter called as electronic air cleaner or air ioniser.

- **Electronic air cleaner/air ionizer Construction:** It consists of set of parallel plates of metal meshes which are of 2 types as given below:

- 1) Aluminium metal mesh
- 2) Gunmetal mesh

Two meshes of each are used i.e. in all 4 meshes are used in the electronic air cleaner. They are arranged in alternate way like after aluminium mesh there is gunmetal mesh and like that.

All of these meshes are coated with FRP (Fiber Reinforced Plastic) coating. FRP coating is nothing but the coating of liquid glass fiber. The reason behind providing this coating is that there should be no risk of spark between the metal meshes and the metal impurities which will come in contact with the meshes. So coating is quite important. This filter requires an external power source for its operation. A 12 volt DC power supply is provided using external battery source.

#### **Working:**

The basic function of Air Ionizer is to ionize (electrically charge) air molecules. It uses high voltage to perform the ionization process. Air ionizers help in air purification that's why it has got the name "Electronic Air Cleaner". Ionisers use electrostatically charged plates to produce positively or negatively charged gas ions that particulate matter sticks to plates.

In present case, the air ioniser we are using is of negative type i.e. the parallel plates of meshes generate negative charge. So when the air approaches towards the inlet hose the plates of air ioniser attracts oppositely charged (positive charge) airborne impurities towards it. As a result the dust particles get stick to it and the air free from impurities passes further.

- **Need of electronic air cleaner**

Without electronic air cleaner the filter paper will encounter the intake air which is accompanied by impurity particles of various sizes. Paper filter will be used extensively and continuously which will result in short life time of the paper filter as it will get choked in a very early stage.

- **Heating element**

It is placed just after the electronic air cleaner near the T-slot. The heating element consists of tungsten wire arranged in the shape of coil. It is nothing but a simple heating coil. It is powered by 220V A.C. power supply. When starting from cold, the engine's combustion efficiency is reduced because the cold engine block draws heat out of the cylinder in the compression stroke.

The result is that fuel is not combusted fully, resulting in blue/white smoke and lower power outputs until the engine has warmed through. This is especially the case with indirect injection engines, which are less thermally efficient.

As the air comes in contact with the coil will get heated and temperature will rise. Due to this if air contains some form of moisture it will get evaporated and only true form of air will pass. This will cause the combustion to take place more effectively.

- **Need of heating element**

First, preheating of air results in complete combustion of fuel and thereby decreasing the emission effect.

This will result in less vibration and noise.

Diesel knocking can be avoided.

Preheating of air also cleans up the moisture in the air.

- **Paper filter.**

Pleated paper filter elements are used for diesel engine air cleaners, because they are efficient, easy to service, and cost-effective.

Although filter media are considerably different from papers used for writing or packaging, etc. As long as a pleated-paper filter is sized appropriately for the airflow volumes encountered in a particular application, such filters present only trivial restriction to flow until the filter has become significantly clogged with dirt. Mechanical air filters remove particles from the air stream because particles come into contact with the surface of fibers in the filter media and adhere to the fibers. The mechanisms by which the particles come into contact with the fibers in the filter media is covered in the air filter mechanisms section.

#### **Convictional air filter (oil bath air filter)**

##### **Working:**

The general principal of an oil bath air cleaner is that incoming air is sucked downwards through the system towards a bowl containing a reservoir of oil. Figure 1 shows how the airflow has to make an abrupt change in direction from travelling downwards towards the oil pool before then heading back upwards to the filter outlet.

The air changes direction easily, however any dirt carried in the air is unable to make the turn due to its inertia so it continues straight on into the oil where it is trapped.

This system is considered satisfactory for engines which are generally working in clean air environments such as Tractor or truck engines work in dusty conditions and so the majority of manufacturers have progressed this principle to make it even more efficient at capturing the last remaining particles of dirt. The bottom of the air inlet pipe is submersed below the oil level so that the air must pass through the oil (Figure 2). At this stage the larger particles are captured by a combination of the inertia principle as detailed above and by centrifugal force created within the oil reservoir. As the air heads back upwards under suction through the filter it now must pass through a packing material (fiber, mesh, foam or metal shavings).

The air carries with it some oil up into the packing material where smaller dust particles become trapped and the cleaned air continues upwards and out of the air cleaner. The process of the air carrying oil with it up into the packing material has the effect of washing the dirt particles back down into the reservoir. Oil bath air cleaners have been largely replaced by dry paper filters in most modern tractors, as the oil makes servicing both messy and inconvenient due to the frequency of cleaning required.

### **Temperature display unit**

A digital temperature display unit is installed which shows the various temperatures like inlet air, heating element, exhaust air etc. It also shows the temperature of the ambient air. It is also powered by 12V D.C. supply.

### **Testing of Model**

All the readings are taken as the average of the 5 five readings for the same load.

## **II. CONCLUSION**

There is no need of reinstallation of the air filter. Only modification can take care of necessary changes in the size are to be made to suit the size and configuration which will add very minimal cost. The advance air filter will defiantly increase the performance of diesel engine in the positive way. Diesel knocking and vibration will decrease the minimum level. Also preheating of air will solve the cold starting of diesel engine in extreme ambient condition.

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