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Design, Development and Evaluation of Air Cleaner for Agricultural Machinery

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ABSTRACT

Background: In agricultural machines especially in harvesting grains because the product is dry lots of particles are produced that its most part is produced in grinding part and separating part (a part that separates grains from straw). Because combine motors are heart. Those two parts most of the particles are directed toward motor and as a result after sometimes because of sucking dirty air filters will become dirty or will be closed that in this case the motor will be damaged. **Objective:** According to above statements one of most important problems about agricultural machinery like combine is finding method for reducing impurity of filter that this paper introduces a method for this problem. **Results:** results of this paper show that by using introduced inventive method all of the above defects have been deleted by the lowest cost so that combine has continued its work continually air has entered motor smoothly and air pollution problem has been deleted too. The need to changing air filter continually has been removed. The base of the work is in this way that a low pressure site has been made at external manifold and vacuum used for cleaning the air that enter the filter. This system sucks entering particles and sends them out through excuse. **Conclusion:** This mechanism works well from the time that the motor is turned on to the time that it is turned off and it has thrift in time and expenses.

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INTRODUCTION

Necessary oxygen for exploiting or burning the fuel in motor is provided from the air so enough air must be entered into cylinder but before this stage it should be cleaned much air is needed for burning petrol. Calculations show that necessary air for burning one liter of gasoline is about 9000 liters. This huge volume of air should be cleaned and refined before entering cylinder especially specially in dirty places where aerosols are so much. This is done by a filter. Filters are two kinds: wet filters of oily ones and dry filters or paper ones (Adamek, 2008 and Cheng 1998).

Dry or wet filters have a part that is called pre- filter. In the entrance of the filter there are blades that circulate the air that enters pre-filter. By circulating the air that is full of particles density of the particles moves them out and around the glass pot. The air is sent out through a central pipe. When the particles are heavy the operator should open the lid of the pot and remove the particles (Diesel programs, 2009).

Wet or oily filters have been used repeatedly for many years. In this kind of filter air enters through a central pipe and while moving downward. It enters the oil that is at the bottom of the plate of air filter. Then the air returns and goes upward through a wire screen. The oil goes upward with air and stays on the wire screen (Diesel programs, 2009).

Oily aerosols stick to the wire ring. The plate should be opened and cleaned from time to time. The plate is filled with fresh oil before it is installed on air filter. In an ideal situation an oily filter can absorb and separate about 98% of aerosols by primary limiting of about 1-2 MPa of pressure drop out. Dry filters or paper ones can separate above 99% of aerosols by making limitation less than 0.5 Pa, so almost all of the motors of vehicles today have dry filters. Dry filters have diverse forms and sizes but their base is the same. In this kind of filter the air full of aerosols moves whirl Pulley while entering the filter so external scale is a kind of pre-filter. Large aerosols move along the scale and pass through obstacle and stay in a special plate. After filling the plate it should be cleaned periodically. Whirl pool air moves inside passes through paper filter and goes out through central pipe. Paper cylinder has wrinkled wall for providing more space for collecting aerosols and less space for air current (Sabnis *et al*, 1995).

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Limiting air current becomes more and more by filling up aerosols on air filters. In limitation becomes too high then the motor can't work properly and its out put will fall. When the filter is dirty it should be cleaned or replaced (Shivakumara and Nanjundoppa, 2009). The filter can be cleaned by pressured air so it can be washed. The filter should be dried before installing again. In agricultural machines especially in combine besides usual aerosols during harvesting grains because the grains are dry lots of aerosols are produced and its most part in produced in grinding part and separating part. Because the motor is near to these parts most of dirty air is directed towards motor and as a result after sometimes air filter will be dirty because it sucks dirty air and sometimes it is closed that in this case the motor will face with some damages as following (Sabnis *et al*, 1995 and Patankar, 1980 and Coellho and Pinho, 2009).

1. When the filter is dirty the air can't enter motor the vacuum inside manifold increases and efficiency of motor decreases.
2. If burning space is in vacuum situation then the oil is pulled into burning space and oil level will decrease and air pollution will increase consequently.
3. When some aerosols pass through air filter and enter into motor space then motor parts such as: piston cylinder rings and other parts will abrade.
4. If air filter is too dirty it should be replaced or cleaned so that after two or three hours of motor working its air filter should be cleaned or replaced.

In this case some time and money are wasted.

The Above problems have set engineers to search for ways for cleaning air filters continually bigger air filters using wirnet as a pre- filter and making automatic air filters have been the results of the researches. But according to the researches cleaning filters by this method is for the first time and no other research has been reported in this field.

Research method is for the first time and no other research has been reported in this field.

Method:

In this design by an inventive method all of the above mentioned defects have been removed by the least cost so that combine has continued its work without delay air has entered into motor smoothly oil decreasing and air pollution problem have been removed the motor hasn't been abraded and there isn't need to cleaned replace air filter repeatedly.

Its principle is in this way that by making a pathway in exouse as it is shown in picture J, a low pressure site is made. The following relation known as Bernoulli equation shows it well.

$$\frac{P_1}{\rho \cdot g} + \frac{V_1^2}{2g} + h_1 = \frac{P_2}{\rho \cdot g} + \frac{V_2^2}{2g} + h_2$$

Where:

P_1 =first pressure

P_2 = second pressure

V_1 = first volume

V_2 = second volume

h_1 =first height

h_2 = second height

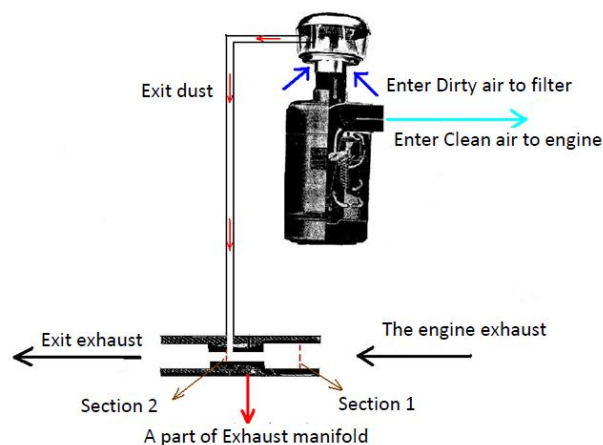


Fig. 1: schematic of air filter cleaner mechanism.

In fact the above relation shows that factors such as pressure speed and height of fluid are constant volumes. In the above schematic highs from sea level for J and 2 sections are constant amounts. In section 2 fluid speed increases because its surface area decreases.

So paying attention to Bernoulli equation its pressure will decrease or in other words low pressure or vacuum site will be made in site 2.

This vacuum is Tran's fered to pre- filter through a pipe. As it has been said, air circulates in pre-filter. Circulation causes the aerosols to pass from sides of the pot because of centrifugal force and as a result clean air passes from middle. Because the vacuum pipe is connected to wall pot it can suck aerosols and send them out through excuse.

Result:

Experiences show that this system can absorb aerosols and send them out through excuse well. It won't decrease motor efficiency and won't lower the air volume that enters into motor. Using this system in some combines that has been evaluated by the inventors, show that this machine can decrease air filter pollution up to 1/5 so that some people have said that they are willing to use it in their combines.

Using this system for cars that work in cleaner air isn't advised but for vehicles such as combine tractor Bulldozer and other machines that work in polluted sites is advised.

The pathway in external manifold paying attention to suck tion need can be narrower or wider. Since smoke is sending out by pressure so this pathway can't unique characteristics of this invention are:

1. Simplicity and the possibility of using it in machinery.
2. Low cost while using it.
3. Being accepted by specialists and theorists.
4. Automatic acting of this mechanism from beginning to end.

Conclusion:

Paying attention to what has been said in order to use this system in machines following cases should be done:

A: changing and reforming excuse in order to make a pathway.

B: transferring suction of excuse to pre-filter through a pipe.

C: changing and reforming pre-filter in order to use the suction

And it has some advantages such as simplicity and possibility of using it in machines its low cost while using in the system its good results while acting in system being accepted by specialists and finally its automatic mechanism from beginning to end.

REFERENCES

- Adamek, D., 2008. Methods for Diesel Engine Air Intake and Filtration System Size Reductions, Donaldson Baldwin C., 2008. Baldwin brochure, 346.
- Cheng, Y.S., M.D. Allen, D.P. Gallegos, and H.C. Yeh, 1988. Drag Force and Slip Correction of Aggregate Aerosols, Aerosol Science and Technology, 8: 199-214.
- Diesel Progress on Line: Products & Technology, 2009. Cummins QSL9 evolves to meet emissions with integrated air-intake to exhaust after treatment - <http://www.dieselpress.com/c/c.aspx/CUM003/news/107>.
- Sabnis, R.D., Q. Cai, & F.W. Chambers, 1995. Flow Distribution Effects upon air Filter performance Measurements" Journal of Engines, SAE, 317: 386-396.
- Patankar, S.V., 1980. Numerical Heat Transfer and Fluid Flow, 5: 11-16. John Anderson, Introduction to Computational Fluid Dynamics, Third Edition, Tata McGraw Publication.
- Coelho, P.M. and F.T. Pinho, 2009. A Generalized Brinkman Number for Non-Newtonian Duct flows, Journal of Non-Newtonian Fluid Mechanics, 156: 202-206.
- Shivakumara, I.S. and C.E. Nanjundappa, 2009. Darcy– Benard–Marangoni Convection in Porous Media, International Journal of Heat and Mass Transfer, 52: 275-282.