

## TITLE OF INVENTION

Improved Air Filter Element for internal combustion engines

## 5 FIELD OF INVENTION

The invention relates to an improved air filter element for use with internal combustion engines, installed in vehicles or in plants and factories.

## 10 DESCRIPTION OF PRIOR ART

The primary function of an air filter in an internal combustion engine is to ensure both smooth airflow and complete removal of particles of dirt, dust, carbon and oil from the airflow. Air filters must therefore must provide minimum restriction allowing high airflow  
15 into an engine, ensuring more and complete combustion. In the vast majority of cases increased airflow will increase engine performance measured by horsepower and throttle response (torque). The performance benefits of maximum airflow is therefore desired. However, if the air taken in has minute particles of dirt, dust and carbon, the performance of the car engine would eventually be affected. Therefore a conflict in  
20 objectives of performance of air filters arise - to maximize air flow, there must be virtually no restriction in air flow but this would allow dirt particles and air borne particles to be taken into the engine, affecting its performance and possibly damaging it eventually. If all particles of dirt, dust, oil and carbon in the air flow going into the internal combustion engine are to be trapped, invariably the air flow would be  
25 restricted as the air has to be forced through some form of air filter.

A typical air filter assembly of the prior art includes a housing and a filter element housed inside the housing to filter contaminants from the air supplied to the engine and adsorb hydrocarbon vapours from the engine, when the engine is shut off. The housing is mounted by suitable means in the engine compartment of a motor vehicle. The housing at the inlet of the air ducting contains a filter which may have any suitable shape, usually complementary to the shape of the housing. The air filter is thus adapted to accommodate the size and packaging requirements of the housing.

Others have attempted to improve air flow by dispensing with the original vehicle air box and replacing it with air intake kits. This invention relates to an improved air filter to be installed in the original vehicle air box.

#### PROBLEM TO BE SOLVED BY THE INVENTION

The air filter element of the prior art are usually made of fabric or paper and are used until the air filter element is clogged with dirt and thrown away. Attempts have been made to have air filter element which can be cleaned and reused. Such filter elements made use of nonwoven fabric which can be repeatedly washed and used by subjecting the surface of the nonwoven fabric to metal sputtering. A solution offered by JP2004255365 is by use of metal sputtering applied onto the surface, thereby, pressure loss of the filter is easily recovered by washing, the air filter can be regenerated and reused and the durability retains even when being washed because of the metal sputtered fiber. In addition, when the non woven fabric subjected to metal sputtering onto the surface and the non woven fabric not subjected to metal sputtering onto the surface are laminated, the non woven fabric subjected

to metal sputtering functions as a pre-filter, prevents the soiling of the non woven fabric not subjected to metal sputtering and can extend the life thereof.

The divergence in objectives of an air filter - to maximize air flow and at the same time to trap dirt particles and air borne particles before these are taken into the engine, has perplexed most inventors. The inventor has proposed the use of a metal filter element which offers good air flow and improved efficiency in capture of particles of dirt, dust, carbon and oil. This improved air filter element can be cleaned and re-used again and again.

#### SUMMARY OF THE INVENTION

It is an object of the invention to have an air filter assembly for an air box connected to an internal combustion engine, the air filter assembly consisting of a frame and a metallic air filter element fitted into the frame, the metallic air filter element made from fine metallic wires woven into a criss cross pattern and formed into a sheet of many undulations in a single direction, thereby increasing the surface area of the fine metallic wire sheet for capture of particles of dirt, dust, carbon and oil found in the surrounding air taken into the air filter assembly through the air box for combustion by the internal combustion engine.

It is a further object of the invention that the air filter assembly consisting of the frame and the metallic air filter element can be removed from the air box and washed and cleaned of the particles of dirt, dust, carbon and oil which have been accumulated in the metallic air filter element after some time of use, and after cleaning, the air filter assembly can re-fitted into the air box for further use.

Preferably, the air filter assembly consisting of a second filter element, the second filter element made of chemically treated substance to remove carbon particles.

Alternatively, the air filter assembly consisting of a second filter element, the second  
5 filter element made of catalyst to further remove dust particles.

Preferably, the undulations in the sheet of metallic air filter element is in a lateral direction.

10 Alternatively, the undulations in the sheet of metallic air filter element is in a longitudinal direction.

Preferably, the criss cross pattern of the fine wires are woven in a Dutch weave  
pattern.

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Alternatively, the criss cross pattern of the fine wires are woven a Square Mesh pattern.

A third object of the invention is to have an air filter assembly for an air box  
20 connected to an internal combustion engine, the air filter assembly consisting of a frame; a metallic air filter element fitted into the frame wherein the metallic air filter element is made from fine metallic sheet with microscopic holes for the passage of air, the sheet having many undulations in a single direction, thereby increasing the surface area of the fine metallic sheet for capture of particles of dirt, dust, carbon  
25 and oil found in the surrounding air taken into the air filter assembly through the air box for combustion by the internal combustion engine.

Preferably the undulations in the fine metallic sheet is in a lateral direction.

Alternatively, the undulations in the fine metallic sheet is in a longitudinal direction.

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Advantageously, the air filter assembly consisting of a frame, a metallic air filter element and a second filter element are individually removable and replaceable.

#### BRIEF DESCRIPTION OF THE DRAWINGS

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Further features and advantages of the invention will now be described, by way of example only, and with reference to the accompanying drawings, in which:

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Figure 1 is a cross section view of the filter assembly using filter element of the prior art.

Figure 2 is an enlarged perspective view of the filter element of the prior art

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Figure 3 is a cross section view of the preferred embodiment of an air filter assembly according to the present invention, as installed in an air box of a motor vehicle.

Figure 4 is a enlarged side view of the same embodiment of the air filter assembly of the present invention.

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Figure 5 is a perspective view of the same embodiment of the air filter assembly of the present invention.

Figure 6 is a front view of the same embodiment of the air filter assembly of the present invention.

Figure 7A and 7B are two graphs showing the improvement in torque and power by the metallic filter element of this invention over a stock filter.

## 10 DESCRIPTION OF PREFERRED EMBODIMENT

The following description of the preferred embodiment is merely exemplary in nature and is in no way intended to limit the invention or its application or uses.

15 Figure 1 shows a typical arrangement of an air filter assembly 10 (prior art) as installed in the engine compartment of a motor vehicle (not shown). The air filter assembly 10 is mounted within an air box 20 which has one or more air inlets 21 for intake of air from the surrounding. The air box also has air ducts 22 which leads to the throttle chamber and eventually to the internal combustion engine (not shown). The air from  
20 the surrounding is sucked into the air box 20 through the air inlets 21, and as the air goes through the air filter element 12 of the air filter assembly 10, particles of dust, dirt, carbon and oil are trapped within the air filter element 12, and thus prevented from passing through and going into the internal combustion engine.

Figure 2 is an enlarged perspective view of a filter element of the prior art. It can be seen that the filter element 12 such as paper filter element will trap air borne particles as the air is sucked through the filter element 12. Over time, the filter element 12 will be clogged with air borne particles and dust particles, affecting its performance. If the filter element 12 is made of paper, some dirt can shaken off by tapping the filter element 12 but such attempts are usually not effective as the dirt is usually bonded to oil and soot particles, and thereby continue to remain inside the filter element 12. It is inevitable that the filter element 12 has to be discarded after some time as it loses its efficacy in capturing particles of dirt, dust, carbon and oil and also impedes air flow into the internal combustion engine.

Figure 3 is a cross section view of the preferred embodiment of an air filter assembly according to the present invention, as installed in the same air box of a motor vehicle. The air filter assembly 30 consists of a frame 31 which holds the air filter element 32. The air filter assembly 30 is mounted within the same air box 20 which has one or more air inlets 21 for intake of air from the surrounding. The air box 20 also has air ducts 22 which leads to the throttle chamber and eventually to the internal combustion engine (not shown). The air from the surrounding is sucked into the air box 20 through the air inlets 21, and as the air goes through the air filter element 32 of the air filter assembly 30, particles of dust, dirt, carbon and oil are trapped within the air filter element 32, and thus prevented from passing through and going into the internal combustion engine.

Figure 4 is a side view of the same embodiment of the air filter assembly of the present invention. The side view would show the air filter element 32 which is made of fine metal wires and formed into an undulating sheet (in cross section). The surface

of the air filter element 32 is therefore uniformly undulating or wavy. Since the effectiveness of the air filter element depends on the surface area, the undulating surface of the air filter element would increase the surface area of the air filter element without making the air filter element too large.

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Figure 5 is a perspective view of the same embodiment of the air filter assembly of the present invention. The fine metallic wires cannot be seen, only the crests 33 of the undulations, hence the lined pattern.

10 Figure 6 is a front view of the same embodiment of the air filter assembly 10 of the present invention. Again, the fine metallic wires cannot be seen, only the crests 33 of the undulations, hence the lined pattern.

In the embodiment shown, the air filter assembly 30 has a shape, complementary to  
15 the shape of the air box in which the air filter assembly 30 is fitted into. The air filter assembly 30 can also be circular as some air boxes are circular in shape.

The air filter element 32 consists of fine metallic wires, unlike the filter element of the prior art which is either paper or sponge. The fine metallic wires are weaved into a  
20 criss-cross pattern to form a wire sheet and the sheet of criss-cross pattern of metallic wires made undulated. In Fig. 5 and Fig. 6, the fine metallic wires cannot be seen, only the crests 33 of the undulations, hence the lined pattern. The criss cross pattern of the fine wires are woven in the pattern referred to as "Dutch weave" or "Square Mesh". The criss cross pattern can also be any weaved pattern.

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The air filter assembly 30 of the invention is installed inside the housing of the air box of a vehicle. The air filter assembly 30 is adapted to accommodate the size and packaging requirements of the housing, which is mounted by suitable means in the engine compartment of a motor vehicle.

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When the engine is switched on, the engine would take in air from the surrounding for combustion. The air from the surrounding would pass through the air filter assembly 30. In the process, the particles of dirt, dust, unburnt carbon and oil found in the surrounding air would be sucked in through the air inlet 21. The air will flow  
10 through the air filter assembly 30. Due to the undulating surface of the fine wire metallic filter 32, more dust particles and unburnt carbon particles would be caught by the interlocking fine wire wires. After some time, the metallic air filter element 32 would be clogged with dirt and dust particles combined with oil and carbon particles. The air filter assembly 30 including the metallic air filter 32 can be taken out of the air box  
15 20 and the fine wire metallic filter 32 washed with soap and water to remove the dirt and dust particles which have been combined with the oil and carbon particles. After washing the metallic air filter element 32, the air filter assembly 30 including the metallic air filter element 32 can be re-installed into the air box 20 for use again.

20 Since the metallic air filter element 32 is made of metal, the metallic air filter element 32 can be used time and again without replacement. This would mean there is no need for a replacement of the metallic air filter element 32, unless it is damaged during the cleaning process. Likewise, there is no need for a replacement of the second filter element, unless the catalyst has been fully used up or damaged during  
25 the cleaning process. This would also apply to the frame. Therefore the entire air filter assembly 30 consisting of the frame, the metallic air filter element 32 and the

second filter can be individually removed and any one component can also be individually replaced, if necessary.

Figure 7A and 7B are two graphs showing the improvement in torque and power by the metallic air filter element 32 of this invention over a stock filter. The subject invention has been tested on a motor vehicle by an independent testing authority and the performance arising from use of the subject invention and a stock in the same vehicle filter compared. A marked improvement in torque and power can be observed from use of the metallic air filter element 32 of the subject invention.

Since the air flows through the holes formed between the fine wires, it is possible for the metallic air filter element 32 to be made from a sheet of metal with fine microscopic holes of approximately similar width as the height and width of the holes formed between the fine wires of the invention. A fine metallic sheet with microscopic holes would similarly allow air to flow through and at the same time, trap particles of dirt, dust, carbon and oil.

The filter assembly 30 can also include a second filter element consisting of the second filter made of chemically treated substance to remove carbon particles. Alternatively, the second filter element can be a catalyst to further remove finer dust particles, thereby increasing the level of capture of particles of dirt and dust in the air taken into the air box. The second filter element can be installed before the metallic air filter element 32 or after the metallic air filter element 32. Alternatively, the second filter element can be incorporated into the metallic air filter element 32.

While an embodiment of the invention have been described, it should be apparent, however, that various modifications, rearrangements, substitutions alterations and adaptations to those embodiments may occur to persons skilled in the art with the attainment of some or all of the advantages of the present invention. Accordingly, it should be clearly understood that the present invention is not intended to be limited by the particular features and structures hereinbefore described and depicted in the accompanying drawings. It is therefore intended to cover all such modifications, alterations and adaptations without departing from the scope and spirit of the present invention as defined by the appended claims.

#### 10 ADVANTAGEOUS EFFECTS OF THE INVENTION

An air filter assembly having an air filter element of metal could be used indefinitely since the metallic air filter element can be used time and again by washing the air filter element. This would mean there is no need for a replacement, unless it is damaged during the cleaning process. The improved air filter assembly would thus reduce the costs of maintenance of said internal combustion engine, be it installed in an original air box for an internal combustion engine connected to a vehicle or in a plant or in a factory or in a building.

20 The air filter assembly, metallic air filter element and second filter element can be manufactured at a low cost and is thus cost effective.

Finally, the improved air filter assembly consisting of a metallic air filter element offers improvement in torque and power.

## CLAIMS

1. An air filter assembly for an original air box for an internal combustion engine, the air filter assembly consisting of:-

- 5           a frame;  
            a metallic air filter element fitted into the frame

**characterized** in that the metallic air filter element is made from fine metallic wires woven into a criss cross pattern and formed into a sheet of many undulations in a  
10   single direction, thereby increasing the surface area of the fine metallic wire sheet for capture of particles of dirt, dust, carbon and oil found in the surrounding air taken into the air filter assembly through the air box for combustion by the internal combustion engine.

15   2. An air filter assembly for an air box connected to an internal combustion engine as claimed in Claim 1, the air filter assembly consisting of a second filter element, the second filter element made of chemically treated substance to remove carbon particles.

20   3. An air filter assembly for an air box connected to an internal combustion engine as claimed in Claim 1, the air filter assembly consisting of a second filter element, the second filter made of catalyst to further remove dust particles.

4. A metallic air filter element for an air filter assembly as claimed in Claim 1  
25   wherein the single direction of undulations in the sheet is in a lateral direction.

5. A metallic air filter element for an air filter assembly as claimed in Claim 1 wherein the single direction of undulations in the sheet is in a longitudinal direction.

6. A fine metallic wire sheet for the air filter assembly as claimed in Claim 1 wherein the criss cross pattern of the fine wires is a Dutch Weave pattern.

7. A fine metallic wire sheet for the air filter assembly as claimed in Claim 1 wherein the criss cross pattern of the fine wires is a Square Mesh pattern.

8. A fine metallic wire sheet for the air filter assembly as claimed in Claim 1 wherein the criss cross pattern of the fine wires is any criss cross pattern.

9. An air filter assembly for an air box connected to an internal combustion engine as claimed in Claim 1 wherein the air filter assembly consisting of the frame and the metallic air filter element can be removed from the air box and washed and cleaned of the particles of dirt, dust, carbon and oil which have been accumulated in the metallic air filter element after some time of use, and after cleaning, the air filter assembly re-fitted into the air box for further use.

10. An air filter assembly for an air box connected to an internal combustion engine, the air filter assembly consisting of:-

a frame;

a metallic air filter element; and

a second filter element,

**characterized** in that both metallic air filter element and second filter are fitted into the frame, the metallic air filter element made from fine metallic sheet with microscopic holes for the passage of air, the sheet having many undulations in a single direction, thereby increasing the surface area of the fine metallic sheet for capture of particles of dirt, dust, carbon and oil found in the surrounding air taken into the air filter assembly through the air box for combustion by the internal combustion engine and the second filter element chemically treated to remove carbon and oil.

10 11. A metallic air filter element for an air filter assembly as claimed in Claim 10 wherein the single direction of undulations in the sheet is in a lateral direction.

12. A metallic air filter element for an air filter assembly as claimed in Claim 10 wherein the single direction of undulations in the sheet is in a longitudinal direction.

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13. An air filter assembly as claimed in Claim 2 consisting of a frame, a metallic air filter element and a second filter element wherein the frame, the metallic air filter element and the second filter element are individually removable and replaceable.

20 14. An air filter assembly as claimed in Claim 10 consisting of a frame, a metallic air filter element and a second filter element wherein the frame, the metallic air filter element and the second filter element are individually removable and replaceable.

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