

AIR CLEANER

The present invention relates to an air cleaner taking advantage of the corona discharge effect, equipped within an automobile.

In Fig. 6 of the accompanying drawings there is shown a conventional air cleaner, as disclosed in Japanese Patent Laid-Open No. Hei 3-266716.

In the drawing, a body case 51 is provided with an inlet 52 and an outlet 53 on the respective left and right hand side surfaces, and a dust collector 54, a control circuit 55 and a blower 56 are arranged in line from the inlet side within the body case 51. A high voltage power source (not shown) is also contained in a proper space within the body case 51.

On the internal surface of the body case 51, a conductive coating material is applied and is connected to an earth part of the control circuit 55 via a cable (not shown).

The dust collector 54 is comprised of a plurality of discharge electrode plates 57 and a plurality of earth electrode plates 58 alternately arranged vertically, a pre-filter 59 arranged on the inlet side, and a V-shaped

collector and deodorizing filter 60 arranged on the opposite side to the pre-filter 59. The collector and deodorizing filter 60 is formed by combining a dust collecting electrostatic charging filter electrically connected to the earth electrode plates 58 and a deodorizing activated carbon filter containing activated carbon. The discharge electrode plates 57 and the earth electrode plates 58 are connected to the high voltage power source via cables (not shown).

The control circuit 55 is formed on a substrate 61 which is mounted on the bottom of the body case 51 under the collector and deodorizing filter 60. The upper side of the control circuit 55 is shielded by a shielding plate 62 which is connected to the earth part of the control circuit 55 and is contacted with the collector and deodorizing filter 60 of the dust collector 54 so as to electrically connect with the earth electrode plates 58.

The blower 56 includes a fan 64 directly connected to a shaft of a drive motor 63 and a volute chamber 65 surrounding the fan 64. The blower 56 is mounted on the bottom of the body case 51 by screws 66 while the fan 64 is positioned in the horizontal state. The volute chamber 65 of the blower 56 is coupled with the outlet 53. By arranging the blower 56 with its fan 64 positioned horizontally positioned, the height of the air cleaner can be kept low.

In this conventional air cleaner described above, the

blower 56 is actuated under control of the control circuit 55 to generate an air flow from the inlet 52 to the outlet 53, and simultaneously a high voltage is applied between the discharge electrode plates 57 and the earth electrode plates 58 from the high voltage power source to generate the corona discharge. Hence, relatively large of dust and dirt particles present in the air introduced into the dust collector 54 from the inlet 52 can be removed by the pre-filter 59, and a small size of dust and dirt particles passing through the pre-filter 59 can be anodized due to the corona discharge generated between the discharge electrode plates 57 and the earth electrode plates 58 and thus be adsorbed by the collector and deodorizing filter 60.

As described above, the dust and dirt in the air can be removed in the dust collector 54, and the cleaned air is then deodorized when passing through the collector and deodorizing filter 60. Hence, the cleaned and deodorized air is drawn into the volute chamber 65 of the blower 56 from the upper and lower parts and is then sent out from the outlet 53.

In this case, electromagnetic noise generated by the discharge part of the dust collector 54 and the drive motor 63 of the blower 56 during the operation can be shielded by the conductive coating material applied on the body case 51.

As described above, in the conventional air cleaner, although the height of the air cleaner can be kept low, in

order to ensure not only the space for providing the volute chamber 65 surrounding the fan 64 of the blower 56 but also the sufficient air flow amount, the depth must be long. As a result, when the air cleaner is fitted in a narrow place such as the interior of an automobile, the suitable mounting place is largely restricted.

Also, since the expensive conductive coating material is applied as the electromagnetic shielding means, the cost is increased. Also, since the conductive coating material part is connected to the earth part of the control circuit 55 via the cable, it takes a long time to fabricate the air cleaner.

Further, the use of the screws 66 for mounting the blower 56 increases the cost and the fabrication time of the air cleaner.

It is therefore an object of the present invention to provide an air cleaner in view of the aforementioned problems of the prior art, which is capable of reducing height and depth dimensions, reducing a producing cost, and shortening a fabrication time.

According to the present invention there is provided an air cleaner, comprising:

a body case having an inlet on an upper surface and an outlet on a side surface;

a dust collector arranged within the body case for collecting dust and dirt contained in air introduced from the inlet, the dust collector having openings facing the inlet and the outlet;

an axial fan arranged between the dust collector and the outlet, the axial fan having a fan directly connected to a drive motor;

a high voltage power source arranged on the opposite side of the dust collector than the axial fan and on the opposite side of the dust collector than the inlet, for applying a high

voltage to the dust collector; and

a controller arranged on the opposite side of the dust collector than the axial fan for controlling a driving of the axial fan;

5 said dust collector, and said controller being arranged in the axial direction of the axial fan; wherein air streams enter the dust collector via the inlet in a direction substantially orthogonal to the axial direction of the axial fan and are diverted in the dust collector to a direction
10 substantially parallel to the axial direction of the fan.

Hence, there is no need to provide a volute chamber in the periphery of a fan. Also, by arranging the dust collector for introducing the air from the upper part, and the high voltage power source and the control circuit as described
15 above, an air flow rate compared with the height and depth dimensions of the body case can be made quite large. As a result, in the state that the sufficient air flow amount is ensured, the dimensions of the height and the depth of the body case can be reduced to miniaturize the air cleaner.

20 Also, the body case may be composed of a combination of upper and lower cases, and at least an upper part of the upper case be composed of an electromagnetic shielding material. The body case may also include connection means for electrically connecting the electromagnetic shielding material with an earth
25 part of the controller when the upper case is assembled with the lower case.

Thus, by constructing the whole or the upper part of

the upper case by the electromagnetic shielding material, there is no need to apply an expensive conductive coating material, and so the production cost is lowered further. In addition, when the upper case is assembled with the lower case, the electro-magnetic shielding material is adapted to be connected with an earth part of the controller, and hence wiring can be omitted which shortens the fabrication time of the air cleaner.

Further, the axial fan may be mounted on the lower case by a pair of holding plates mounted upright on the lower case and a U-shaped resilient holding member having both ends to be engaged with upper parts of the holding plates, while a protective frame is surrounded by the holding plates and the resilient holding member. The resilient holding member may include a pair of pressure contact projections at the ends, in an opposed state to contact under pressure with an upper surface of the protective frame of the axial fan when the axial fan is mounted on the lower case, and to bias the resilient holding member so as to close both ends of the resilient holding member by the contacting under pressure.

Hence, by holding the axial fan by engaging the resilient holding member with the pair of holding plates, screws for mounting the axial fan can be omitted to lower the cost and to shorten the fabrication time. Further, since the pair of pressure contact projections of the resilient holding member bias both the ends of the resilient

holding member to be pushed to the holding plates when the axial fan is mounted by using the holding plates and the resilient holding member, an unexpected disengagement between the holding plates and the resilient holding member can be prevented. As a result, the mounting of the axial fan can be more exactly carried out.

The invention will be further described by way of example in the following detailed description, taken in conjunction with the accompanying drawings, in which:

Fig. 1 is a longitudinal cross sectional view of an air cleaner according to the present invention;

Fig. 2 is a top view of the air cleaner shown in Fig. 1, in which an upper case is removed;

Fig. 3 is a side cross section showing a mounting state of an axial fan of the air cleaner shown in Fig. 1;

Fig. 4 is a fragmentary enlarged view of Fig. 3;

Fig. 5 is a fragmentary enlarged view of Fig. 1; and

Fig. 6 is a longitudinal cross sectional view of a conventional air cleaner.

Referring now to the drawings, wherein like reference characters designate like or corresponding parts throughout the views and thus the repeated description thereof can be omitted for brevity, there is shown in Figs. 1 and 2 one embodiment of an air cleaner according to the present invention.

As shown in Figs. 1 and 2, in the air cleaner, a body case 1 is provided with an inlet 2 on the upper surface and an outlet 3 on the left hand side surface, and a dust collector 4 is arranged in almost the central portion. Between the dust collector 4 and the outlet 3 in the left hand side of the body case 1, a deodorizing filter 5 using honeycomb activated carbon 5a, an axial fan 6 as a blower, and a fragrant part 7 including a housing 7b containing an aromatic 7a and an aromatic control electromagnetic valve 7c are arranged in series in a line. Further, on the opposite side to the axial fan 6 with respect to the dust collector 4 in the right hand side of the body case 1, a high voltage power source 8 for applying a high voltage to the dust collector 4, a control circuit 9 formed on a substrate 9a for controlling the axial fan 6, and a connector 10 for the power supply are arranged. This air cleaner is mounted onto a mount plate 12 provided within an automobile by using a thumbscrew 11 secured on the bottom of the body case 1.

The body case 1 is composed of a combination of lower and upper cases 1a and 1b. The lower case 1a is composed of

an insulating material such as a synthetic resin or the like and an upper case 1b. The lower part of the upper case 1b is composed of the same material as the lower case 1a and the upper part of the upper case 1b is composed of punched metal 13 of a conductive material. This punched metal 13 is provided as an electromagnetic shielding material, and, when the upper case 1b is combined with the lower case 1a, the punched metal 13 is electrically connected with an earth part 9b composed of a jumper cable in the control circuit 9 via a resilient plate member 14 having conductivity, as hereinafter described in detail. The punched metal 13 is formed with a number of small holes which are used as the inlet 2. The upper punched metal 13 of the upper case 1b and the lower insulating part of the same are coupled with each other by inserting lower ends of the punched metal 13 into mount holes formed in the upper ends of the lower insulating part. The lower insulating part of the upper case 1b is provided with the outlet 3 on the left hand side surface and a detachable lever 17 on the internal surface in the right hand side end. The detachable lever 17 for locking the assembled state of the lower case 1a and the upper case 1b by engaging with an aperture 16 formed in the lower case 1a is mounted to the upper case 1b by a screw 18. In this case, the whole of the upper case 1b can be composed of the punched metal 13.

The dust collector 4 includes a plurality of discharge

electrode plates 19 with discharge wires 19a on their upperparts, and a plurality of earth electrode plates 20 which are alternately arranged and held within an electrode plate holding case 21. The electrode plate holding case 21 is opened at its upper and left side surfaces facing the inlet 2 and the outlet 3. The discharge electrode plates 19 and the earth electrode plates 20 are mounted in the electrode plate holding case 21 by using two resilient mount members 22 fitted at their lower portions while the discharge electrode plates 19 and the earth electrode plates 20 are separately connected with each other.

In the dust collector 4, on the opposite side to the outlet 3, that is, the lower part on the control circuit side, a power source containing space 23 for containing the high voltage power source 8 is formed in the cutout shape. In the power source containing space 23, the positive and negative electrodes 8a and 8b of the high voltage power source 8 are directly contacted with a both of the exposed discharge electrode plate 19 and earth electrode plate 20 without using lead wires so as to apply the high voltage between the discharge electrode plates 19 and the earth electrode plates 20. In this embodiment, as described above, even when the power source containing space 23 is formed in the lower part of the dust collector 4, the air introduced from the upper part of the dust collector 4 flows sideways so as to avoid the power source containing

space 23, and thus no influence is given to the dust collection performance of the dust collector 4.

In the axial fan 6 arranged between the dust collector 4 and the outlet 3, a fan 6b is directly coupled with a shaft of a drive motor 6a, and a rectangular protective frame 6c is formed in the periphery of the fan 6b. Hence, the axial fan 6 generates the air flow directing to the outlet 3 in parallel with the shaft of the drive motor 6a. That is, in this case, there is no need to provide a volute chamber in the periphery of the fan 6b.

As shown in Figs. 3 and 4, the axial fan 6 is held upright on the lower case 1a in the state surrounded by the rectangular protective frame 6c by using a pair of holding plates 24 vertically mounted on the lower case 1a and a U-shaped resilient holding member 25 combined with the holding plates 24 by engaging hooks 25a formed on both the ends of the U-shaped resilient holding member 25 with engaging depressions 24a formed on the external upper parts of the holding plates 24.

Further, in the upper part of the U-shaped resilient holding member 25, there are provided two pairs of pressure contact projections 25b to contact under pressure with the upper surface of the rectangular protective frame 6c of the axial fan 6 when the axial fan 6 is mounted. In this embodiment, two pairs of the pressure contact projections 25b are formed, as shown in Fig. 2. When the pressure

contact projections 25b are contacted under pressure with the rectangular protective frame 6c to be deformed or bent upwards (in a direction A in Fig. 4), both the ends of the U-shaped resilient holding member 25 receive a moment pivoting to the internal direction (in a direction B in Fig. 4) around the base parts of the pressure contact projections 25b. That is, by contacting under pressure with the rectangular protective frame 6c, the pressure contact projections 25b bias both the ends of the U-shaped resilient holding member 25 to push onto the external surfaces of the holding plates 24. As a result, any unexpected disengagement between the engaging depressions 24a of the holding plates 24 and the engaging hooks 25a of the U-shaped resilient holding member 25 can be prevented and thus the mounting of the axial fan 6 can be reliably carried out.

On the other hand, the substrate 9a of the control circuit 9 located on the opposite side to the axial fan 6 is assembled upright in a predetermined position within a protective cover 26 formed on the lower case 1a. The resilient plate member 14 is fixed on an upper surface of one lower stage of the protective cover 26 of the control circuit 9 by using a screw 27.

As shown in Figs. 1, 2 and 5, an intermediate part of the resilient plate member 14 having a rectangular form is secured to the protective cover 26 of the control circuit 9 by the screw 27 so as to be supported horizontally on the

lower case 1a. One end 14a of the resilient plate member 14 is passed through an opening 26a of the protective cover 26 and is inserted into the protective cover 26 so as to contact with the earth part 9b of the control circuit 9 positioned in the upper part of the upright substrate 9a. The other end 14b of the resilient plate member 14 is contacted with the lower end of the punched metal 13 projecting downwards from a mount hole 15 of the upper case 1b. That is, the resilient plate member 14 is adapted to be formed and arranged so that the one end 14a of the resilient plate member 14 may be contacted under pressure with the earth part 9b of the control circuit 9 when the substrate 9a of the control circuit 9 is assembled within the protective cover 26, and the other end 14b of the resilient plate member 14 may be contacted under pressure with the lower end of the punched metal 13 of the upper case 1b when the upper case 1b is assembled with the lower case 1a. Hence, the punched metal 13 as the electromagnetic shielding material can be grounded via the resilient plate member 14.

In the above-described air cleaner, the power is supplied to the high voltage power source 8 from the outside via the power supply connector 10 to generate the high voltage (approximately 6 kV), and the generated high voltage is applied between the discharge electrode plates 19 and the earth electrode plates 20 in the dust collector 4. Then, the corona discharge is generated between the discharge

wires 19a of the discharge electrode plates 19 and the earth electrode plates 20. At the same time, when the axial fan 6 is controlled by the control circuit 9 to actuate the axial fan 6, the air is introduced into the body case 1 through the inlet 2. At this time, when the external air is passed through the punched metal 13, relatively large dust and dirt contained in the air can be removed.

The air drawn into the body case 1 is then introduced into the dust collector 4 from its upper part, and the dust and dirt in the air passing through the punched metal 13 are anodized by the corona discharge generated within the dust collector 4 to be adsorbed to the earth electrode plates 20. Thus, the cleaned air flows from the left hand side part of the dust collector 4 to be introduced towards the axial fan 6, and the air is then deodorized by the honeycomb activated carbon 5a of the deodorizing filter 5 positioned before the axial fan 6 when passing through the deodorizing filter 5. The cleaned and deodorized air is aromatised as required at the fragrant part 7 and is then discharged outside of the body case 1 from the outlet 3 and a part of the punched metal 13.

In this case, the electromagnetic noise generated in the discharge part of the dust collector 4 and the drive motor 6a of the axial fan 6 during the operation can be shielded by the punched metal 13.

In the air cleaner according to the present invention,

since the axial fan 6 without the volute chamber provided around the fan 6b, the dust collector 4 for introducing the air from the upper part, the high voltage power source 8 and the control circuit 9 are arranged in line, as described above, the air flow rate compared with both the dimensions of the height and the depth of the body case 1 can be made quite large, for example, 70 to 90% in terms of the cross section. As a result, the sufficient air flow amount can be ensured, and both the dimensions of the height and the depth of the body case 1 can be reduced to miniaturize the air cleaner. Further, since the power source containing space 23 is formed in the lower part of the dust collector 4 so as to arrange the high voltage power source 8 therein, the space within the body case 1 can be effectively utilized and thus the air cleaner can be further miniaturized.

Also, since the control circuit 9 is arranged on the opposite side to the axial fan 6 with respect to the dust collector 4, the control circuit 9 can be separated from the air flow and protected from the dust and the dirt, and hence the reliability of the air cleaner can be further improved.

Further, since the upper case 1b is constructed by using the punched metal 13 as the electromagnetic shielding material, it is not necessary to apply an expensive conductive coating material which reduces the production cost. In addition, since the punched metal 13 is adapted to

be electrically connected with the earth part 9b of the control circuit 9 via the resilient plate member 14 when the upper case 1b is assembled with the lower case 1a, the wiring can be omitted and thus the fabrication time of the air cleaner can be shortened.

Furthermore, since the axial fan 6 as the blower is held by engaging the holding plates 24 with the U-shaped resilient holding member 25 having the pressure contact projections 25b in the top portion without using any screws, the fabrication time can be shortened and the cost can be reduced.

While the present invention has been described with reference to the particular illustrative embodiment, it is not to be restricted by this embodiment but it is to be appreciated that those skilled in the art can change or modify the embodiment without departing from the scope of the present invention as defined by the appended claims.



CLAIMS

1. An air cleaner, comprising:

a body case having an inlet on an upper surface and an outlet on a side surface;

5 a dust collector arranged within the body case for collecting dust and dirt contained in air introduced from the inlet, the dust collector having openings facing the inlet and the outlet;

an axial fan arranged between the dust collector and the outlet, the axial fan having a fan directly connected to a drive motor;

a high voltage power source arranged on the opposite side of the dust collector than the axial fan and on the opposite side of the dust collector than the inlet, for applying a high voltage to the dust collector; and

a controller arranged on the opposite side of the dust collector than the axial fan for controlling a driving of the axial fan;

said dust collector and said controller being arranged in the axial direction of the axial fan; wherein air streams enter the dust collector via the inlet in a direction substantially orthogonal to the axial direction of the axial fan and are diverted in the dust collector to a direction substantially parallel to the axial direction of the fan.

25 2. The air cleaner as claimed in claim 1, wherein the controller includes a circuit board in an upright position.

3. The air cleaner claimed in claim 1 or 2, wherein the dust collector has a rectangular solid form and a part of the dust collector is cut out for accommodating the high voltage power source in a cutout space.

4. The air cleaner claimed in claims 1, 2 or 3, wherein the body case is composed of a combination of upper



and lower cases to be assembled, and at least an upper part of the upper case is composed of an electromagnetic shielding material, and wherein the body case includes connection means for electrically connecting the electromagnetic shielding material with an earth part of the controller when the upper and lower cases are assembled.

5. The air cleaner claimed in claim 4 wherein the connection means is composed of a resilient plate material and includes an earth connection part in one end, to be contacted with the earth part of the controller, a shielding material connection part in another end, to be contacted with the electromagnetic shielding material, and a fixing part in an intermediate part, to be fixed to the lower case, and wherein the connection means is fixed to the lower case while the earth connection part and the earth part are contacted with each other, and the electromagnetic shielding material is contacted with the shielding material connection part when the upper case is assembled with the lower case.

6. The air cleaner claimed in any one of the preceding claims wherein the axial fan includes:

a rectangular protective frame in a periphery of the axial fan;

a pair of holding plates mounted upright on the lower case; and



a U-shaped resilient holding member having both ends to be engaged with upper parts of the holding plates,

wherein the fan is mounted on the lower case while the protective frame is surrounded by the holding plates and the resilient holding member, and

wherein the resilient holding member includes a pair of pressure contact projections to contact under pressure with an upper surface of the protective frame of the axial fan when the axial fan is mounted on the lower case, and to bias the resilient holding member so as to close both ends of the resilient holding member by the contacting under pressure.

7. An air cleaner constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 5 of the accompanying drawings.

8.. A vehicle including an air cleaner according to any one of the preceding claims.