Dec. 29, 1931. W. C. WILSON 1,838,512

METHOD OF CLEANING AIR

Original Filed May 11, 1927

Fig. 1

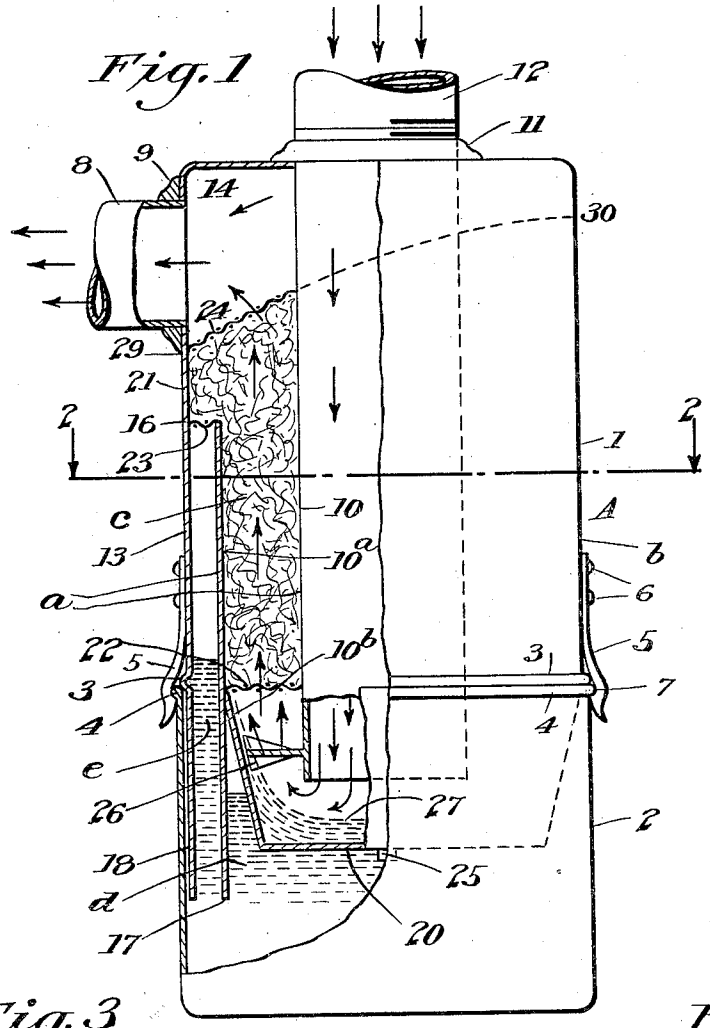


Fig. 3

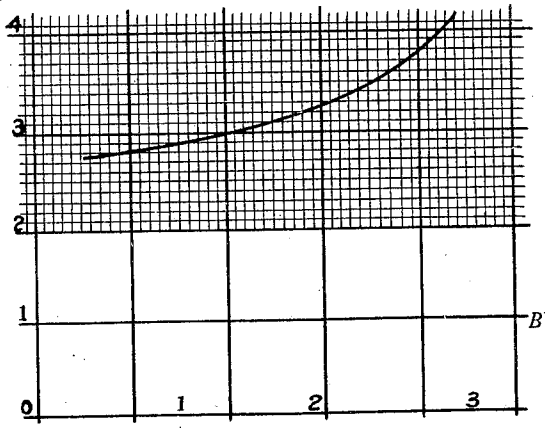
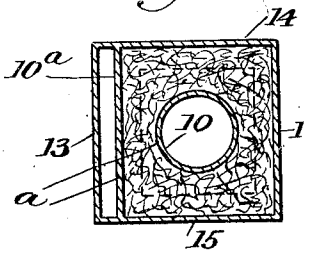


Fig. 2



INVENTOR:
Walter C. Wilson,
BY Blakeslee & Brown
ATTORNEYS.

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UNITED STATES PATENT OFFICE

WALTER C. WILSON, OF MONROVIA, CALIFORNIA

METHOD OF CLEANING AIR

Original application filed May 11, 1927, Serial No. 190,532. Divided and this application filed June 4, 1928. Serial No. 282,799.

This invention relates to a method of cleaning air.

Particularly, the invention is applicable to all existing forms of air displacement apparatus, such as internal combustion engines, compressors, and the like.

This application is a division of my copending application Serial No. 190,532, filed May 11, 1927, for means of cleaning air.

It is now recognized that air to be mixed with certain vapors to form explosive mixtures should be free from foreign substances, such as dust particles, and if the air is not free from all such particles, that the working parts of the engine are often seriously damaged. Such dust particles or foreign matter also tend to injure the valves of the engine, as well as to score the cylinder walls and pistons, resulting in a loss of compression. One of the chief objections, however, to an air cleaner has been that such a cleaner imposes considerable resistance to the flow of air to the carburetor, and thence to the engine cylinders, with the result that the engine does not draw in explosive vapors properly proportioned for efficient operation. As a consequence, the engine would not develop its full power output at varying speeds and loads imposed on the engine. There are many elements that enter into the question of proper air supply admixed with gasoline and delivered to the engine cylinders, such as skin friction in the passage of the air through the pipes. Certain air cleaners build up a back pressure, with the result that an engine associated therewith will not run properly. It is obvious that in the case of hydrocarbon or internal combustion engines, the gasoline is drawn from the carburetor, in accordance with the flow of air around the jet of said carburetor.

Another object is the novel method of cleaning air in which air restriction at all velocities is reduced to a minimum.

Another object is the novel method of cleaning air in which there is no accumulated air restriction at any given velocity of air flow.

Another object is the novel method of cleaning air in which the air is thoroughly cleansed of all foreign matter.

Another object is the provision of an air cleaner providing a slight momentarily increased air restriction on accelerated velocities of air flow.

Another object is the novel method of cleaning air of obstructions and in such a manner that the relation between resistance to the flow of air and the quantity of air delivered is approximately constant.

In the drawings:

Fig. 1 is an elevation of the improved air cleaner, shown partly in section, and partly fragmentarily, and illustrating the construction thereof;

Fig. 2 is a sectional view on the line 2—2 of Fig. 1; and

Fig. 3 is a plotted curve showing the results of depression tests made upon the air cleaner shown in Figs. 1 and 2.

Corresponding parts in all the figures are designated by the same reference characters.

Referring now with particularity to the drawings, I have for the purpose of illustrating the method of cleaning air provided an air cleaner, designated as an entirety by A, and of which *a* designates primary casing members, *b* a secondary casing, *c* means for trapping foreign matter, *d* means acting in conjunction with the means *e* for cleansing the air, and means *e* for directing a path of flow of the means *d*, all of which elements may be utilized in practising an embodiment of the invention.

The secondary casing *b* may assume any shape or form, that in the drawings being substantially square in transverse section, as shown in Fig. 2, and the said casing is formed in two parts, as shown at 1 and 2. In this connection, it will be seen that the part 1 is elongated and provided with a peripheral bead 3. The part 2, which constitutes a removable base, is provided with a rim flange 4, and a portion of the casing 1 below the bead 3 is adapted to be received within the confines of the member 2, when the parts are in cooperative relation, as illustrated in Fig. 1. It will be noted that when the parts are in said cooperative rela-

tion that the rim flange 4 will bear against the bead 3. One or more snap catches 5 are adapted to hold the two portions of such casing in cooperative working relation. In this connection, such catch may comprise a member having an inherent springlike quality, an adjacent end portion of which is secured by suitable means 6 to the part 1 of the casing, while an opposite end portion of such catch is notched at 7, so as to engage beneath the rim flange 4. The part 1 of the primary casing has associated therewith an outlet tube 8. This tube may be secured to the part 1 of the casing in any approved manner, such as by welding, as indicated at 9.

The primary casing *a* is in three parts, 10, 10*a*, and 10*b*. The part 10 may comprise in the present instance a tube associated with any convenient wall of the casing *a*, as illustrated at 11, and such tube is adapted to have communication with the air intake tube 12, in fact it being an extension of tube 12 down into the casing to a point near the bottom of the upper portion of the vessel. The part 10*a* of the primary casing, *a*, comprises a wall member spaced from the outer wall 13 of the vessel casing, and transversely extending between the outer walls 14 and 15 of said casing. This wall, 10*a*, does not extend the entire height of the vessel, but commences near the vessel bottom, as at 17 in the drawings, and extends upward about three-fourths the height of the vessel, terminating at an elevation considerably below the outlet opening 8 as illustrated at 16, this leaves a clear space between the lower end of the wall, 10*a*, and the bottom of the vessel, and also a considerable space between the upper end and the outlet opening. Adapted to be connected, or otherwise associated, with the upper casing 1 and the baffle wall 10*a* is the member 10*b*, which in cross section resembles an inverted, hollow, truncated pyramid. Three of the side walls of said member 10*b* are joined with the walls of the section 1 of the secondary casing, while one of said walls of said member 10*b* adjoins and contacts with the wall 10*a*. While the lower end of the tube 10, forming part of the primary casing is spaced above the base 20, as shown, the said tube extends downwards far enough to terminate well down into the inverted hollow pyramid portion, which latter forms a liquid holding vessel as shown in Fig. 1.

The means *c* is a filter formed of some fibrous materials, which said fibrous material fills all of the space included between the side walls of the upper portion 1 of the vessel and the periphery of the member 10. That space lying between baffle wall 10*a* and outer wall 13, is, however, not filled with the fibrous material. Fig. 1 shows this filtering material as lying between the uppermost edge of the pyramid-shaped vessel and a point well below outlet opening 8, but above the upper end 16 of baffle wall 10*a*, also the top of the filter is inclined as indicated by the curved line, partly dotted, 29—30 in Fig. 1. To retain said fibrous material in position and confine it within its upper and lower limits, I may provide any suitable means, such as the horizontal screens shown at 22, 23 and 24. The screen shown at 22 would prevent the fibrous material from dropping into the pyramidal vessel 20 and the screen 23 would hold said fibrous material from dropping into the space included between the walls 10*a* and 13. The screen 24, in the present instance, has a slight slope between the walls of the section 1 of the casing. This is in order to hold the fibrous material in such a position that there is a substantially unrestricted air passage to the outlet of said casing.

The means *d* may comprise any suitable liquid or fluid, with which liquid or fluid, air drawn through the said device *a* is adapted to contact. The means *e* constitutes the passageway included between the wall 10*a* and the wall 13 of the casing, whereby any of the said liquid or fluid directed through the fibrous material is permitted to flow back through the said passageway and into the casing section 2.

The base or liquid-holding vessel, 10*b*, is provided with an opening 25 through which the liquid may flow in either direction, so that a rapid flow of air through the tube 10 will set up a pressure which will drive some of the liquid out of vessel 20 into the external, surrounding reservoir portion, thereby increasing the area of the passageway for the larger volume of air. Such action would cause the level of the outer mass of liquid to be raised, so that the static pressure of the liquid, counter to the air pressure, will increase with the quantity of air flowing. Diminution in the quantity of air passing through the tube 10 would decrease the pressure against the liquid *d* and the static head set up by the elevation of the surface of the outer mass of liquid, would cause a flow of liquid into vessel 10*b* through opening 25, thereby reducing the area on the passageway under the end of the intake tube 10.

If it is desired to give the air a vortex or centrifugal action, I may provide a stationary fan 26. This fan in the present instance would be included between the members 10 and 10*a*.

The operation, uses and advantages of the device just described are as follows:

Assuming that the outlet tube 8 is associated with the intake of a carburetor, the said carburetor in turn being connected to the intake manifold of an internal combustion engine, upon the downstroke of the pistons within the cylinders of said internal

combustion engine, a charge of hydrocarbon vapor, admixed with air, will be drawn into said cylinders. This air drawn into the cylinders will be drawn through the inlet tube 12, through the tube 10, and outwardly through the outlet tube 8, as illustrated by arrows in Fig. 1. However, this air will be washed or cleansed of foreign matter in its passage through the cleaner A. This is accomplished by filling the secondary casing part 2 with some liquid, which liquid will be received within the member 10*b*, and likewise between the walls 10*a* and 13, when the parts 1 and 2 are in cooperative relation, as shown in Fig. 1. The end of the tube 10 may or may not be immersed in the liquid within the member 10*b*. When air is directed through the tube 10 it will contact with a surface of the liquid and force the level of the liquid downwardly, as shown at 27, and upwardly of the sides of the member 10*b*. Some of this liquid will be forced into the fibrous material constituting the filter, and the air, by this combined liquid and filter will be washed, as it were, of foreign particles. The liquid, after wetting the fibrous material, will be carried upwardly within said fibrous material both by capillary action and by the air currents. After the fibrous material becomes saturated, additional liquid, entrained with the air, will flow downwards, falling back into vessel 10*b*, except that which drains into the space between baffle wall 10*a* and outer wall 13, which latter will be caught in the bottom vessel 2, and, when conditions require will be restored to vessel 10*b* through opening 25. The air passing through the fibrous material is constantly washed, the said liquid and moist fibres catching the foreign material and allowing it to deposit within the lower vessel 2 of the secondary casing. If the path of flow of the liquid were not continuous, there would be an accumulated back pressure, as the liquid would gradually saturate the filter. This, of course, cannot happen with the present air cleaner, as constructed.

Attention is directed to Fig. 3, which is a graph upon which appears a curve, the abscissas of said graph indicating the air flow per second, and the ordinates the depression in air flow. This is commonly understood to be water depression in inches. The inventor utilized a manometer tube as between the air intake and the air outlet, and the depression constants were measured in this manner for different air velocities.

It will be seen that the test showed that the slope of the resultant curve is very slight, thus indicating that the air cleaner was very efficient in respect to depression. The height above or depth of immersion of the tube 10 within the liquid does not change the slope of the curve, but only raises its distance relative to the origin. This might be expressed by stating that the varying liquid levels do not alter the relations of the variables of the depression of the curve and in which the constant has an approximate direct relation to the varied liquid levels. By depression constant, resistance to flow is, of course, meant.

It is apparent, after considering the construction of the air cleaner as described, and a consideration of the graph, why this particular cleaner operates so efficiently. Furthermore, by the automatic varying of the liquid level within the member 10*b*, it is apparent that when the downstroke occurs in either engine or any type of air displacement apparatus, such liquid level will effect a slight momentary increased restriction to the path of air flow, and thus allow any carburetor with which said device is associated to function with maximum efficiency on accelerated loads. In other words, by varying this liquid level it is possible to introduce what may be termed an inertia effect. Assuming that the device is utilized in conjunction with a carburetor, which carburetor is associated with an internal combustion engine, if the carburetor does not utilize a dashpot, the sudden air flow past the nozzle of the carburetor will not draw a sufficient amount of the volatile hydrocarbon, due to inertia of the hydrocarbon liquid. By the method just mentioned, however, this inertia effect is overcome, so that the carburetor may function properly.

I do not intend by this device in any manner to complicate the problems of correct carburation, but this device aids the action of the carburetor in the manner just outlined.

If any accumulated back pressure occurred in the air flow through the cleaner, it is evident that the slope of the curve on the graph would change, and that such slope would become more abrupt. Accumulated back pressure would become greater as the velocity of air flow increases. It will be seen that in the present air cleaner there is no accumulated back pressure for different air flows. This is a point of great importance. I attribute the fact that there is very little increased back pressure in the air flow to the fact that air passing through the member 10 has a direct impingement upon the surface of the liquid within the member 10*b*, which will force the liquid level farther below the mouth of the member 10, as illustrated in Fig. 1. And to the fact that the liquid is then forced upwardly, so that it follows the path of air flow through the filter, it being, of course, realized that capillary attraction will likewise cause the liquid to rise within said filter, and this liquid is allowed to flow back into the casing section 2 through the passage *e*. In other words, I have a closed circuit for the flow of the liquid. In this manner the integrity of the liquid is preserved, with the

result that no attention is necessary to the replenishment of liquid or fluid of any character after the said liquid or fluid has been placed within the part 2 of the casing. It has been found that an internal combustion engine utilizing one of the present air cleaners is efficient at all speeds and loads.

It is obvious that various changes and modifications and variations may be made in practising the invention in departure from the particular showing of the drawings, without departing from the true spirit of the invention.

Having thus disclosed my invention, I claim and desire to secure by Letters Patent:

1. The method of removing deleterious substances from air passed through a cleaner having an air passageway and a filter within said passageway, which consists in rapidly passing said air through said passageway and filter in contact with a liquid, said air lifting said liquid into said filter for contact with the deleterious substances, then limiting accumulating back pressure in said filter due to the presence of said deleterious substances and liquid, by removing said liquid and deleterious substances at a selected zone of said filter and out of the normal flow path of said air therethrough.

2. The method of removing deleterious substances from air passed through a cleaner having an air passageway and a filter within said passageway, which consists in rapidly passing said air through said passageway and filter, in contact with a liquid, said air lifting said liquid into said filter for contact with the deleterious substances, then limiting accumulating back pressure in said filter due to the presence of said deleterious substances and liquid, by removing said liquid and deleterious substances at a selected zone of said filter and out of the normal flow path of said air therethrough, then directing the liquid and the deleterious substances to a given zone in the cleaner out of the air flow path.

3. The method of removing deleterious substances from air passed through a cleaner having an air passageway and a filter contained therein, which consists in passing the air through said passageway and filter in a continuous flow path and providing a continuous liquid flow path through said filter diverging from the air flow path therethrough at a selected zone in said filter.

4. The method of removing deleterious substances from air passed through a cleaner having an air passageway opening adjacent a body of liquid and a passageway having confined therein a filter above said body of liquid, which consists in directing air through said passageways in such a manner that the air first contacts with said body of liquid to cause said liquid to pass with said air into said filter, then separating the liquid flow path from the air flow path through said filter at a zone adjacent a selected portion of said filter.

5. The method of removing deleterious substances from air passed through a cleaner having an air passageway opening adjacent a body of liquid and a passageway adapted to have confined therein a filter above said body of liquid, which consists in directing air through said passageways in such a manner that the air first contacts with said body of liquid to cause said liquid to pass with said air into said filter, then separating the liquid flow path from the air flow path through said filter at a zone adjacent a selected portion of said filter, then redirecting the liquid flow to the body of the liquid out of the air flow path.

In testimony whereof, I have signed my name to this specification at Los Angeles, California, this 15th day of May, 1928.

WALTER C. WILSON.