Dec. 29, 1931. W. C. WILSON 1,838,511

DEVICE FOR CLEANING AIR

Filed May 11, 1927

Fig. 1

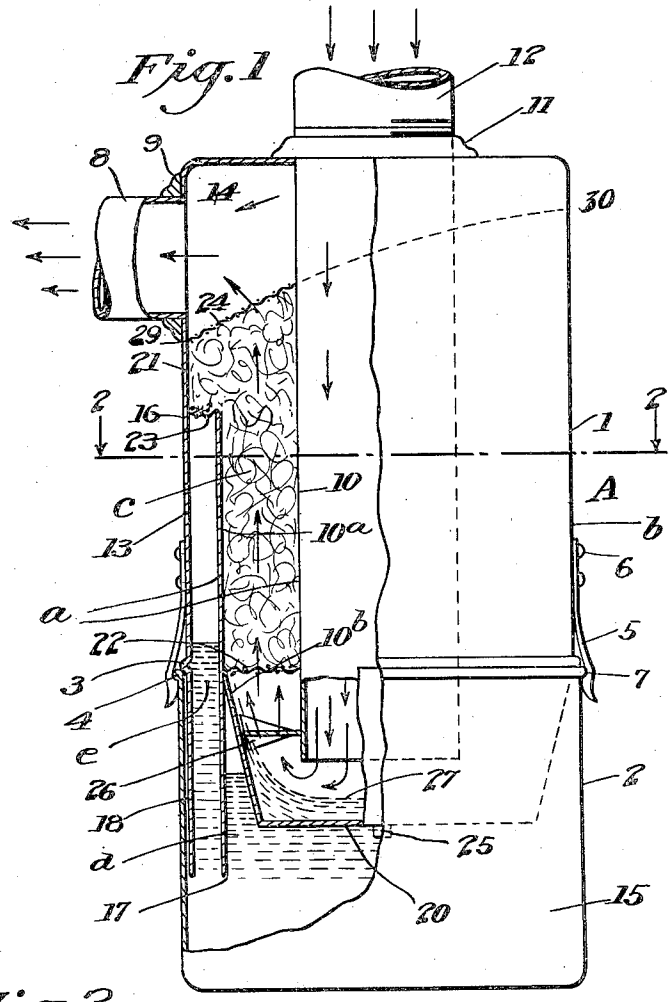


Fig. 3

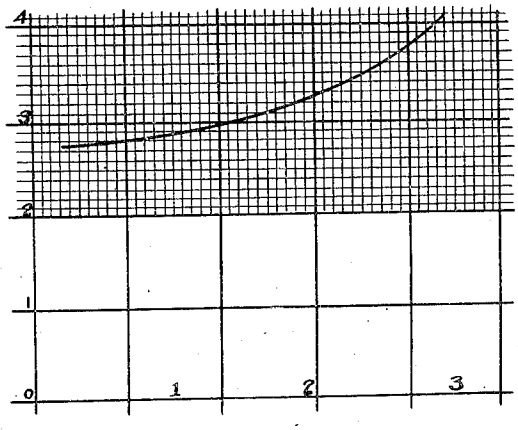
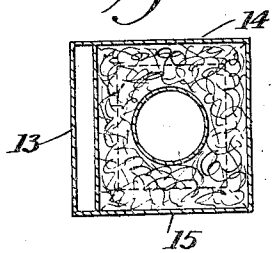


Fig. 2



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UNITED STATES PATENT OFFICE

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DEVICE FOR CLEANING AIR

Application filed May 11, 1927. Serial No. 190,532.

This invention relates to a device for cleaning air.

Particularly, the invention is applicable to all existing forms of air displacement apparatus, such as internal combustion engines, compressors and the like. More particularly, the invention is adaptable for use with carburetors associated with internal combustion engines.

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.

The present invention has for an object the provision of an efficient air cleaner which does not, in any manner, interfere with the proper working adjustment of a carburetor.

Another object is the provision of an air cleaner in which air restriction at all velocities is reduced to a minimum.

Another object is the provision of an air cleaner in which there is no accumulated air restriction at any given velocity of air flow.

Another object is the provision of an air cleaner 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 provision of an air cleaner so constructed and formed that the relation between resistance to the flow of air therethrough and the quantity of the air is approximately constant.

Other objects include an air cleaner which is simple of construction and manufacture, highly efficient in use and service and generally superior to existing forms of cleaners.

With the above and other objects in view, the invention consists in the novel and useful provision, formation, construction and relative arrangement of parts, members and features, all as shown in a certain embodiment in the accompanying drawings, described generally, and more particularly pointed out in the claims.

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 a reduced scale and taken upon 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, the improved air cleaner is designated as an entirety by A, and of which *a* designates partitioning members, *b* a casing *c* means for trapping foreign matter, *d* means acting in conjunction with the means *c* 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 casing *b* may assume any shape or form, that in the drawings being substantial-

ly 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 part 1 below the bead 3 is adapted to be received within the confines of the casing part 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 relation 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 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 partitioning members *a* consists of 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 *b*, 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* comprises a wall member spaced from the outer wall 13 of the 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 casing, but commences near the vessel bottom, as at 17 in the drawings, and extends upward about three-fourths the height of the casing, 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 removable base, and also a considerable space between the upper end and the outlet opening. Adapted to be connected, or otherwise associated, with the upper casing part 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 casing part 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, 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 material, which 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 included between a lowermost elevation approximately coincident with the uppermost edge of the pyramid-shaped vessel, and an upper limit at an elevation below outlet opening 8, but above the upper end of baffle 10*a*. 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. *e* constitutes means of communication or a 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 member 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 10 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 of the passageway under the end of the intake tube 10.

If it is desired to give the air a vortex or centrifugal movement, I may provide a louvered plate 26. This plate 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 the 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 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 removable base 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 base 2 of the 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.

It is also to be understood that during operation of this device the amount of liquid delivered through the opening 25 into the air stream passing through the cleaner is dependent upon the static head maintained by the column of liquid in the passageway *e*. The level of liquid in said passageway depends upon the resistance produced in the contact material. Said resistance produces a depression on the air outlet side of the contact material. As the upper portion of the contact material above the top of the baffle 10*a* contains very little liquid substantially the depression at the outlet is applied at the top of the passageway *e*. By this action the resistance of the contact material indirectly through the depression which it creates at the outlet of the cleaner determines the liquid level in the passageway *e*. As previously stated, the level of the liquid in said passageway and the static head thereby created on the opening 25 determines the amount of liquid delivered through said opening. It is,

therefore, evident that upon the delivery of an amount of liquid to the contact material which causes an appreciable resistance therein, the increased depression created at the outlet raises the liquid level in the passageway *e* and reduces the amount of liquid delivered into the air stream. In this manner means are provided for regulating the delivery of liquid to the contact material by the pressure at an intermediate zone thereof whereby the effective area for air flow through the contact material varies in accordance with the rate of air flow therethrough, it being previously explained that the effective area for air flow is dependent upon the amount of liquid delivered to the contact material. It is to be understood that the liquid level in the passageway *e* does not directly determine the static head of liquid acting upon the opening 25. The action is indirect. Due to liquid from the removable base 15 of the casing being drawn up into the passageway *e* by the depression therein, the liquid level is lowered. The head of liquid acting upon the opening 25 is therefore dependent upon the liquid level in the passageway *e*.

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. In a device of the character disclosed, a two-part casing, one of said parts being telescopically received within the other part and slightly spaced from said other part, a baffle wall within the casing, an air intake pipe within the casing, a filter confined in part between said baffle wall and said air intake pipe, and an air outlet pipe for said casing, said casing being adapted to confine a liquid whereby passage of air through the air intake pipe will contact with said liquid to raise the liquid into the filter, return of a quantity of said liquid being between said baffle wall and the casing.

2. In a device of the character disclosed, a casing, an air intake pipe having an outlet within the casing, said casing being formed with an air outlet, said casing being adapted to confine a body of liquid adjacent the outlet of the air intake pipe, a filter interposed between the outlet of the air intake pipe and the air outlet of the casing, and means out of the path of air flow to the filter for directing liquid flow in said filter to the body of liquid.

3. In a device of the character disclosed, a casing having a removable base, an air intake member in part received within the casing, a wall within the casing and spaced from the intake member, a base member secured to said wall and having an opening therein; a filter within the said casing being provided with an air outlet spaced from the filter, said removable base being adapted to confine a body of liquid to in part be passed through said opening in the base member; air in its passage through said air intake member contacting with the surface of said liquid to in turn cause passage of the liquid through said filter, flow of liquid from said filter being in part between the said wall and casing and out of the path of air flow.

4. A device of the character disclosed, a casing including a separable base adapted to confine a body of liquid, said base being positioned with respect to the casing so as to form a liquid seal therewith, a portion of the surface of the liquid being open to atmospheric pressure, an air intake tube having an outlet end within the casing, said outlet end being adjacent the body of liquid, a baffle within said casing and extending into the liquid, and a filter between the air intake pipe and said baffle, said casing being provided with an air outlet above the filter.

5. In a device for cleaning air, a casing filtering material positioned in the casing,

means therein whereby there may be a continuous flow path of air into and out of said casing, said casing being formed to house a liquid, means within said casing whereby said liquid may have a given flow path therein, said means being formed to cause the liquid flow path and air flow path to coincide through a portion of the filtering material and then to cause the liquid to flow in a path separate from the air flow path as the air continues its flow through additional filtering material.

6. In a device of the character disclosed, a casing, an air admission tube within said casing, a filter in part surrounding said air admission tube, said casing being formed with an air exit from said filter, a baffle separating a portion of said filter from said casing, said casing being adapted to house a liquid whereby when air is passed through the inlet tube said air contacts with said liquid for passage of said liquid and air into said filter, the baffle separating the filter from the casing providing a passage-way for return of the liquid from the filter.

7. In a device of the character disclosed, a casing, an air outlet therefrom, an air intake tube within said casing, a baffle separating a zone of said casing, a filter within said casing between the baffle and the intake tube and surrounding in part said tube, said casing being adapted to house a liquid, air in its passage through the intake tube contacting with the liquid within said casing for passage in part through said filter toward the outlet of the casing, and means for causing a whirl in said combined air and liquid prior to passage thereof into said filter.

8. A device of the character disclosed, a casing, a removable base spaced at one part thereof from said casing and adapted to form a liquid seal therewith, a baffle wall within the casing, a vessel positioned in the casing and forming a part thereof, an air inlet tube extending through the casing to a zone adjacent the vessel, and a filter between the baffle and the air inlet tube.

9. In a device of the character disclosed, a filter with air inlet and air outlet means, means admitting a liquid to an air stream passing through said filter adjacent the air inlet, means whereby the liquid is caused to pass out of the air stream at an intermediate zone of the filter, and means independent from the air stream for removing the liquid from said zone.

10. In a device of the character disclosed, a filter, said filter being provided with air inlet and air outlet means, means adjacent the air inlet admitting a liquid to an air stream passing through said filter, said filter provided with means effective to substantially reduce the velocity of the air stream carrying the liquid at an intermediate zone of the filter whereby the liquid separates from the air stream, and means independent from the air stream for removing the liquid from said zone.

11. In a device of the character disclosed, a filter, said filter being provided with air inlet and air outlet means, means adjacent the air inlet admitting a liquid to an air stream passing through said filter adjacent the air inlet, means effective to substantially reduce the resistance to air flow at an intermediate zone of the filter whereby the liquid separates from the air stream, and means independent from the air stream for removing the liquid from said zone.

12. In a device of the character disclosed, a filter being provided with an air inlet and air outlet means, and means admitting a liquid to an air stream passing through said filter adjacent the air inlet, the cross sectional area of the filter in the direction of flow being materially increased at an intermediate zone whereby the liquid is released from the air stream.

13. In a device of the character disclosed, a filter provided with air inlet and air outlet means, said means being adapted to provide for air flow in an upward direction through said filter, means for admitting a liquid to the air stream passing through said filter, means effective to substantially reduce the velocity of the air stream at an intermediate zone of the filter, and an outlet means provided for the removal of liquid which separates from the air stream due to the reduction in velocity.

14. An air cleaner comprising a casing, a casing section positioned at the bottom of said casing, said casing section being adapted to contain liquid at a predetermined depth, a liquid vessel positioned in the casing, means for communication between the casing section and the liquid vessel whereby liquid may flow into said vessel, an air inlet tube extending into the casing and having its inner end terminating adjacent the liquid vessel, an air outlet from the casing, filtering material positioned in the casing between the outlet and the inner end of the air inlet tube, and means forming a liquid return passage-way from an intermediate zone of the filtering material to the liquid vessel.

15. An air cleaner comprising a liquid containing vessel, means for delivering liquid thereto, an air inlet tube having an end positioned adjacent the liquid level in the vessel, means forming an air passage-way extending upwardly from said vessel, means effective to produce a resistance to air flow in a portion of said passage-way whereby an air flow of comparatively low velocity through the air inlet tube is effective to lift liquid through said portion of said passage-way, said passage-way being formed beyond said portion to lower the resistance to the air flow whereby the liquid may separate from the air, and

means whereby the liquid may drain from the separation zone.

16. A device as set forth in claim 15, in which the means effective to produce a resistance to air flow is contact material disposed in the passage-way and extending downwardly into close proximity to the normal liquid level in the vessel.

17. A device as set forth in claim 15, in which the means effective to produce a resistance to air flow is means to subdivide said passage-way into a plurality of small passages whereby liquid brought into contact therewith forms an increased resistance to air flow in the passage-way.

18. An air cleaner of the character disclosed comprising a casing, contact material disposed therein, air inlet and outlet means for the casing, means for delivering liquid to the contact material, the liquid forming in conjunction with the contact material, resistance producing means to air flow, and means providing for regulating the delivery of liquid to the contact material by the pressure at an intermediate zone thereof, whereby the effective area for air flow through the contact material varies in accordance with the rate of air flow therethrough.

In testimony whereof, I have signed my name to this specification.

WALTER C. WILSON.