Nov. 7, 1939. T. W. HALLERBERG 2,179,229

APPARATUS FOR CLEANING AIR

Filed Nov. 25, 1935 2 Sheets-Sheet 1

Fig. 1

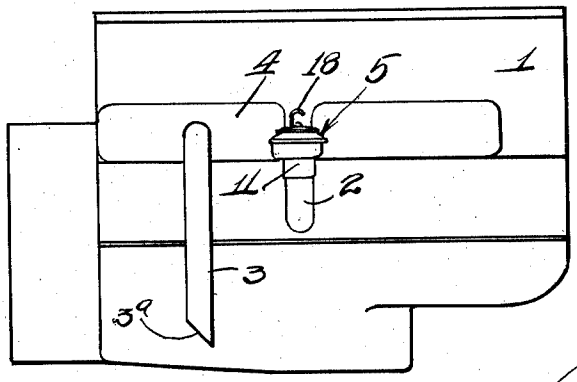


Fig. 2

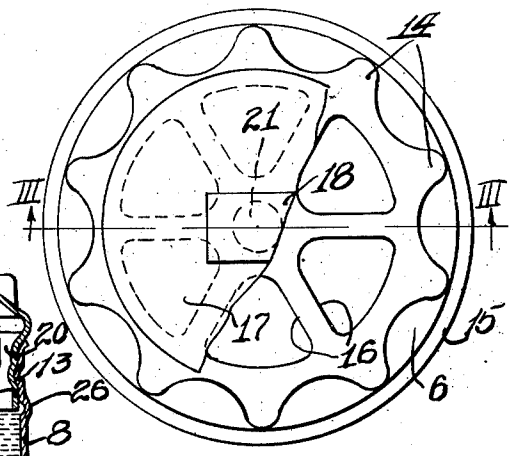


Fig. 3

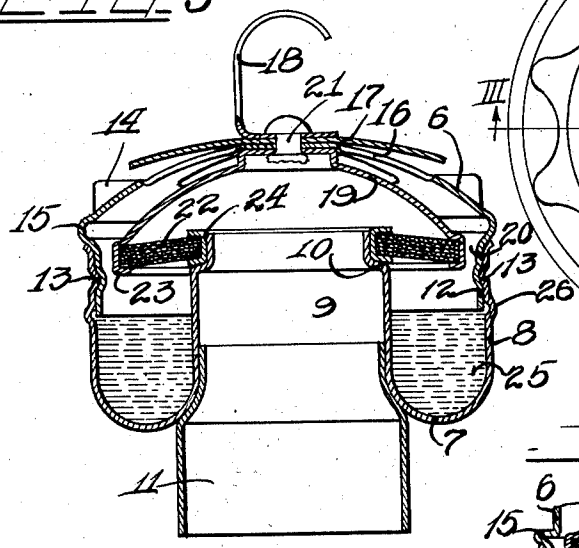
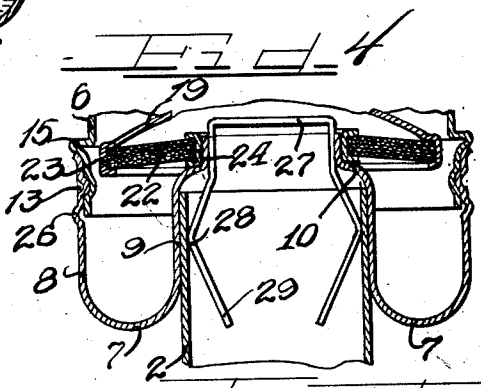


Fig. 4



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Fig. 5

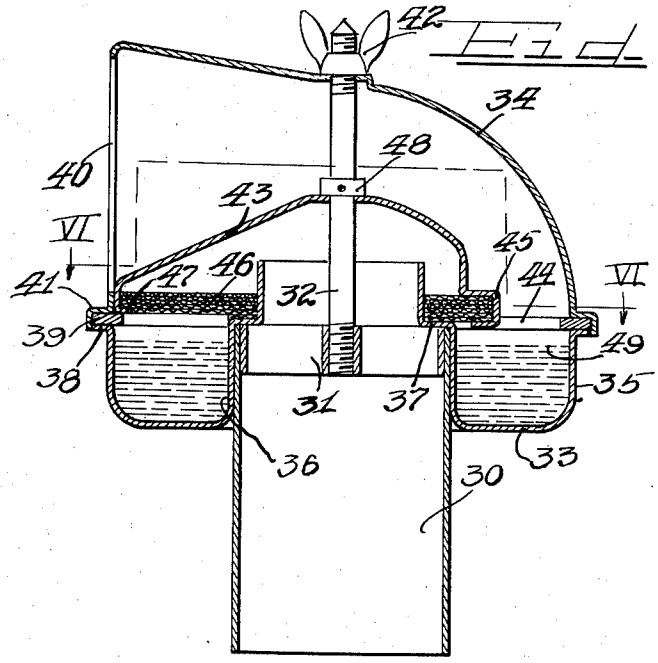
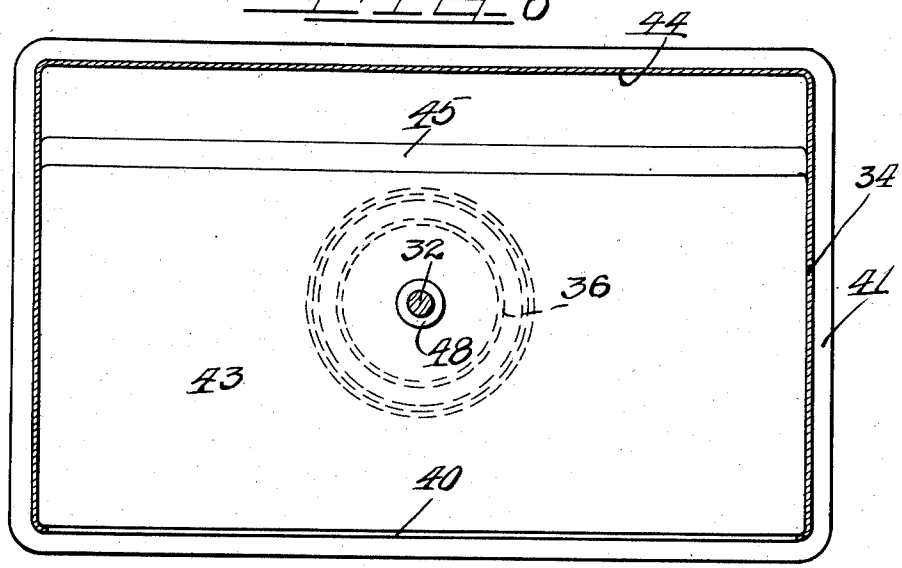


Fig. 6



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UNITED STATES PATENT OFFICE

2,179,229

APPARATUS FOR CLEANING AIR

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Application November 25, 1935, Serial No. 51,398

5 Claims. (Cl. 121—194)

This invention relates to improvements in apparatus for cleaning air, and more particularly to an air cleaner for disposition over or connection to an air intake, the cleaner being highly desirable for use in connection with the air intake of a crank case ventilation system, although the invention will have other uses and purposes as will be apparent to one skilled in the art.

It has now become substantially universally recognized that the most efficient type of air cleaner for use in connection with internal combustion engines is the so-called "liquid bath" type, wherein a cleansing liquid is utilized. Such air cleaners, insofar as I am aware, have heretofore been used only with the intake conduit of a carbureter, the intake of an air compressor, or some other such installation, but they have not been used with a crank case breather pipe or with the intake pipe for a crank case ventilation system. This was due in the main to the fact that in most instances such air cleaners are dependent upon a higher degree of suction than is obtainable in a crank case for the efficient operation of the cleaner. I am aware that certain types of cleaners have been provided for crank case breather pipes, but these cleaners have operated at much below satisfactory efficiency, and in certain instances, a complete breathing action, including both inhalation and exhalation through the same opening, was needed in the crank case of an internal combustion engine. Such breather type cleaners would not therefore operate satisfactorily in connection with crank case ventilation as distinguished from crank case breathing.

With the foregoing in mind, it is an important object of the present invention to provide a liquid bath air cleaner highly efficient in operation in connection with either a crank case breather pipe or the intake pipe for crank case ventilation.

Another object of this invention is the provision of an air cleaner for association with an operable mechanism, and which is highly efficient in operation, even when the volume of air passing therethrough is extremely small.

Also an object of this invention is the provision of an air cleaner including both a filter and a cleansing liquid, and wherein the filter is both impregnated and washed by the cleansing liquid as a result of vibrations set up by the operation of the mechanism with which the cleaner is associated, whereby the cleaner will operate at a high degree of efficiency regardless of the suction created in the mechanism or the volume of air passing through the cleaner.

It is a further object of this invention to provide an economical air cleaner highly efficient in operation in connection with a crank case ventilation system.

Still another object of the invention is the provision of an air cleaner embodying a filter element disposed across the air path through the cleaner and wherein the inherent resiliency of the filter element is relied upon to effect a tight seal.

Also a feature of this invention is the provision of an air cleaner embodying both a screen type filter element and a cleansing liquid, the arrangement being such that a thin film of cleansing liquid is being continually made and broken on the screen during the operation of the cleaner.

An important feature of the invention is the provision of an air cleaner for association with the crank case ventilation system of an internal combustion engine, and wherein a substantially horizontal screen filtering element is disposed in such proximity to a cleansing liquid that stationary waves caused by the operation of the engine will cause the liquid to wash the screen.

It is also an object of this invention to provide an air cleaner having a relatively large inlet substantially in the form of a scoop.

While some of the more salient features, characteristics and advantages of the present invention have been hereinabove pointed out, others will become apparent from the following disclosures, taken in conjunction with the accompanying drawings, in which:

Figure 1 is a fragmentary diagrammatic view in elevation of an internal combustion engine, showing the same equipped with an air cleaner embodying principles of the present invention.

Figure 2 is an enlarged plan view of the air cleaner alone, with parts broken away.

Figure 3 is a vertical sectional view of the air cleaner, taken substantially as indicated by the line III—III of Figure 2, with parts shown in elevation.

Figure 4 is a vertical sectional view of an air cleaner of the same type as is shown in Figures 2 and 3, but embodying a slightly different form of mounting means.

Figure 5 is a central vertical sectional view of a different form of air cleaner embodying principles of the present invention, showing parts in elevation.

Figure 6 is a plan sectional view of the air

cleaner of Figure 5, taken substantially as indicated by the staggered section line VI—VI of Figure 5.

As shown on the drawings:

The embodiment of the present invention illustrated in Figures 1, 2 and 3 is shown associated with the crank case ventilation system of an internal combustion engine of the automotive type. An internal combustion engine 1 is diagrammatically illustrated, and includes a crank case inlet pipe 2, and a crank case outlet pipe 3 emanating from one of the valve cover plates 4. The outlet pipe 3 is provided with an obliquely cut end 3a, so that there will be a suction or aspiration of air from the pipe 3 due to the engine fan and the forward movement of the car with which the engine is associated. An air cleaner, generally indicated by numeral 5 is shown mounted upon the crank case inlet pipe 2, which, in this instance, is also the pipe through which the engine is provided with crank case lubricant.

With reference to Figure 3, it will be seen that the air cleaner 5 includes a casing comprising two sections, an upper section 6 and a lower section 7. The lower casing section 7 is preferably of one piece of material in the form of an annular U, having an outer wall 8 and an inner wall 9, the latter defining the outlet passage from the cleaner. The walls 8 and 9 are preferably concentric so that the outlet passage defined by the wall 9 is centrally disposed relatively to the cleaner. At the upper region thereof, the wall 9 is inset to form an annular shoulder 10 for a purpose that will later appear.

Preferably spot-welded to the lower casing section 7 is an outlet conduit member 11 sized for an intimate telescopic fit over the upper end of the intake pipe 2 of the engine or, if desired, this conduit 11 may be press-fitted over or into the intake pipe 2 so as not to warrant removal of the lower casing section from the intake pipe. The upper casing section 6 is substantially in the form of a dome top having a skirt 12 depending therefrom for intimate association with the outer wall of the lower section.

Both the skirt 12 and upper portion of the side wall 8 are deformed, as indicated at 13, to provide a bayonet slot connection between the two casing sections, the upper casing section having spaced projections 14 thereon to provide finger holds for manipulating the upper casing section to engage it with and disengage it from the lower casing section. Immediately above the bayonet slot connection, the upper casing section is beaded, as indicated at 15, merely for purposes of decoration in tending to conceal the connection and also for the purpose of limiting the downward movement of the upper section relatively to the lower section so that the parts may be more easily joined.

In the high part of the dome portion thereof, the upper casing section is provided with a series of openings 16 through which air enters the cleaner. These openings are protected by a shield 17 which prevents debris from falling into the cleaner. Disposed above the shield 17 is a hook 18 by means of which the upper casing section may be hung upon the tie rod beneath the engine hood of an automotive vehicle or on some other suitable object when removed from the lower section.

Inside the upper casing section is a dome-shaped member 19 which functions as a filter holder and also as a partition member to define a definite course of travel for air passing through the cleaner. This member 19 is of such a size as to extend outwardly well beyond the outer edges of the openings 16 and provide a relatively narrow annular passage 20 between itself and the skirt 12 for incoming air. The hook 18, shield 17, upper casing section and the member 19 are all centrally securely held together by a rivet 21 or equivalent securing means.

A filter element 22 is carried by the member 19, a plurality of layers of screen, such as window screen, being one form of element suitable for this purpose. When a screen of this character is used, it is preferable that each layer be slightly waved or otherwise deformed so that there is no tendency for the layers to pack together, and the respective layers are progressively staggered. The member 19 is provided on its outer edge with a depending formation 23 in the form of an internal annular channel for holding the filter element 22. Likewise, a similar channel member 24 is in engagement with the filter element through the central aperture in the element, this holding member 24 being seated upon the aforesaid shoulder 10 when the filter is in place.

From the showing in Figure 3, it will be noted that the filter element 22 is substantially horizontally disposed, but slopes slightly upwardly and inwardly. This slight slope is purposely designed in the structure as an aid to securing an effective seal between the holding member 24 and the shoulder 10 so that air will not pass therebetween but must pass through the filter. The construction is such that when the upper casing section together with the filter and member 19 is placed on the lower section and secured thereto by means of the bayonet connection 13, the holding member 24 will strike the shoulder 10 just prior to the connection being effected. Thus, the inner portion of the screen will be deflected upwardly when connection is established between the two casing sections and the seal is maintained by means of the inherent resiliency of the screen.

In operation, the cleaner is highly efficient. Air must enter through the openings 16, pass downwardly over the upper face of the dome-shaped member 19, through the relatively narrow annular channel 20, curve upwardly through the filter 22, and again reverse direction and pass through the outlet 11, being guided in this movement by the inside surface of the member 19. When the cleaner is used in connection with the intake to a crank case ventilation system, as shown in the drawings, there will not be a sufficient quantity of air passing through the cleaner to turbulate or otherwise disturb a cleansing liquid 25 contained in the lower casing section, preferably to a level defined by an external bead 26 on this casing section. However, the arrangement is such that the filter 22 is disposed in such proximity to the liquid level that the filter will be effectively washed by stationary waves set up in the liquid as a result of operation of the internal combustion engine. The cleansing liquid is preferably oil of the character put in the crank case and it will therefore be seen that during the passage of air through the cleaner, a film of oil is being continuously made and broken over the surface of the filter, resulting in an effective cleansing of the air, and due to the action of the aforesaid stationary waves, all of the dirt and debris removed

from the air will be washed from the filter to the bottom of the lower casing section.

In view of the narrow passage 20 and the fact that the inlet openings 16 are disposed inwardly so as to leave ample imperforate surface of the upper casing section 6 over the inlet 20, there will be no danger of any of the cleansing liquid splashing out of the cleaner through the inlet path regardless of the terrain over which the vehicle may travel.

In Figure 4, I have shown a slightly different form of attachment means for the cleaner. In this instance, the cleaner structure itself is identical with that shown in Figures 2 and 3. To provide attachment over an intake 2, for example, to a crank case ventilation system, a clamping yoke 27 is preferably spot-welded or otherwise secured to the inner wall 9 of the lower casing section above the shoulder 10. This clamping yoke includes a pair of resilient legs being outwardly deflected as at 28, and having an obliquely extending portion 29 below the deflection. The entire cleaner may therefore be pushed over the intake 2, as clearly seen in Figure 4, with the legs of the yoke inside the intake conduit, these legs establishing a gripping upon the intake conduit between themselves and the inner wall 9 of the lower casing section. With this construction, the entire cleaner may readily be removed from the intake pipe, and as before explained, the upper casing section may be removed from the lower by a suitable operation of the bayonet slot connection. The cleaner structure itself shown in Figure 4 operates the same as described hereinabove in connection with the embodiment of Figures 2 and 3.

In connection with both the cleaners shown in Figures 3 and 4, it will be noted that the upper edge of the outside wall 8 of the lower casing section is in a plane slightly lower than the upper edge of the inside wall 9. This construction is designed to prevent a filling station attendant from carelessly pouring oil into the cleaner rather than through the central opening directly into pipe 2 leading to the crank case. If the filling station attendant is careless and pours into the lower casing section, the oil will overflow outside rather than inside, calling attention to the fact that the proper oil level in the cleaner has been altered and forcing the attendant to fill the crank case with lubricant in the proper manner.

In Figures 5 and 6, I have shown a slightly different form of cleaner, but one that will operate with the same degree of efficiency. In some instances, it may be deemed desirable to provide a cleaner somewhat in the form of a scoop disposed in the path of a direct blast of air from the engine fan so as to insure an adequate supply of air for effective crank case ventilation.

In this instance, a conduit 30 which may be the intake to the crank case of an internal combustion engine or which may be a part of the cleaner for intimate telescopic fit in connection with the intake to the crank case is provided with a spider or yoke 31 preferably spot-welded to the inside face of the conduit. This yoke is formed for a threaded connection with the lower end of a fastening bolt 32. The cleaner includes a lower section 33 and an upper section 34 selectively separable therefrom. The lower section is formed to provide an annular liquid sump around the conduit 30, and includes an outer wall 35 and an inner wall 36. The inner wall is reduced in diameter in the upper portion thereof to provide an annular substantially horizontal shoulder 37 to support a filter element as will later appear. The outer wall 35 is outwardly flanged as at 38 at the upper end thereof to provide a seat for a peripheral gasket 39.

Both the upper casing section 34 and the lower casing section 33 are somewhat rectangular in shape, as shown, or they may be somewhat triangular in shape, in order to provide a relatively wide inlet opening 40. The upper casing section is peripherally stepped outwardly and downwardly, as indicated at 41, to overlie the aforesaid gasket 39 and the edge of the lower casing section, as seen clearly in Figure 5. The upper casing section is removably held in position and clamps down upon the gasket 39 by means of a thumb nut 42 connected with the aforesaid bolt 32 externally of the casing.

Inside the casing, a shield or baffle 43 defines a path for incoming air through the upper casing section to the rear portion of the cleaner, this shield effectively blocking any direct descent of incoming air inside the opening 40, but leaving a passage 44 at the rear of the cleaner. At the rear side thereof, the shield 43 is deformed as at 45 to hold a filter element 46 which may be of the same character as the above described filter element 22. At the forward end thereof, the baffle is also shaped as at 47 to support the filter element 46 which is centrally apertured to fit over the upper end of the inner wall 36 of the lower section and rest upon the aforesaid shoulder 37. The baffle 43 together with the filter element is held downwardly to establish a proper seal adjacent the shoulder 37 by means of a collar 48 secured to the bolt 32. When the bolt is tightened in position inside the yoke 31, it will be seen that the collar 48 will effectively press the baffle 43 and filter downwardly into position.

The lower casing section is shaped to hold a cleansing liquid preferably to a level substantially as indicated by the dotted line 49 which is in such proximity to the filter 46 that stationary waves set up by the operation of the internal combustion engine will effectively wash the filter.

Incoming air enters through the opening 40, passes rearwardly over the baffle 43, and descends through the opening 44 at the rear of the cleaner, passing upwardly through the filter 46 beneath the baffle 43 and downwardly through the outlet. The cleansing action is the same as hereinabove described in connection with the showing in Figures 2 and 3.

If the conduit 30 is the intake to the crank case of the internal combustion engine, the cleaner is effectively clamped thereon by means of the bolt 32 and thumb nut 42. The release of the thumb nut 42 and the disengagement of the bolt 32 from the yoke 31 permits the entire cleaner to be removed from the conduit 30. On the other hand, if the conduit 30 is a part of the cleaner, it may be spot welded to the inner wall 36 of the lower casing section, and the entire cleaner may be removed by disengaging the conduit 30 from the intake to the crank case.

From the foregoing, it will be apparent that I have provided an air cleaner highly desirable for use in connection with a crank case ventilation system. The air cleaner is highly efficient in action, removing substantially all dirt and debris from entering air and relying upon a new principle of operation, namely, the washing of the filter by stationary waves developed in a liquid sump by means of operation of an internal combustion engine. It will also be noted that the

cleaner is compact in form, requires little space, and may be economically manufactured and used.

I am aware that many changes may be made and numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I, therefore, do not purpose limiting the patent granted hereon otherwise than is necessitated by the appended claims.

I claim as my invention:

1. In an air cleaner, a casing comprising separable sections, said casing having an inlet and an outlet, an imperforate member in one casing section positioned over said outlet in spaced relationship thereto, a filter element carried at one edge thereof by said member, and the other casing section having a seat for the other edge of said element disposed slightly higher than the carried end whereby when said casing sections are joined a seal is effected between said filter element and said seat by the inherent resiliency of said filter element.

2. In an air cleaner, a casing comprising separable sections, a filter element carried in one of said sections by a margin and having a free margin, and the other section having a seat for the free margin of said element sufficiently out of line to slightly warp said element when the sections are joined to provide a seal by the inherent resiliency of said element.

3. In an air cleaner, a casing having an inlet, outlet conduit means opening through the bottom of the casing, said casing being shaped to provide a liquid sump around said conduit means, a shoulder on said conduit means, imperforate baffle means defining a path from said inlet to said conduit means, a filter element around said conduit with one margin seated on said shoulder and the other margin held by said baffle means, said shoulder being sufficiently out of line with the holding part of said baffle means to cause a warping of said filter element.

4. In an air cleaner, a casing having an inlet and an outlet, baffle means in said casing defining a path from the inlet to the outlet, and a resilient filter element across said passage and disposed in a warped position to effect a seal by the resiliency of said element.

5. In an air cleaner, a casing having an inlet and an outlet, imperforate means defining a path for air traveling from the inlet to the outlet, said casing having a liquid sump therein, and a resilient filter element disposed in a warped position across said path to effect a seal with the aid of the resiliency of the filter element, said filter element being spaced from the liquid in said sump but sufficiently close thereto to be washed by liquid agitated by vibration.

THEODORE W. HALLERBERG.