Sept. 22, 1953 J. W. LOFTON ET AL 2,653,016

AIR CLEANING DEVICE

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Fig. 1.

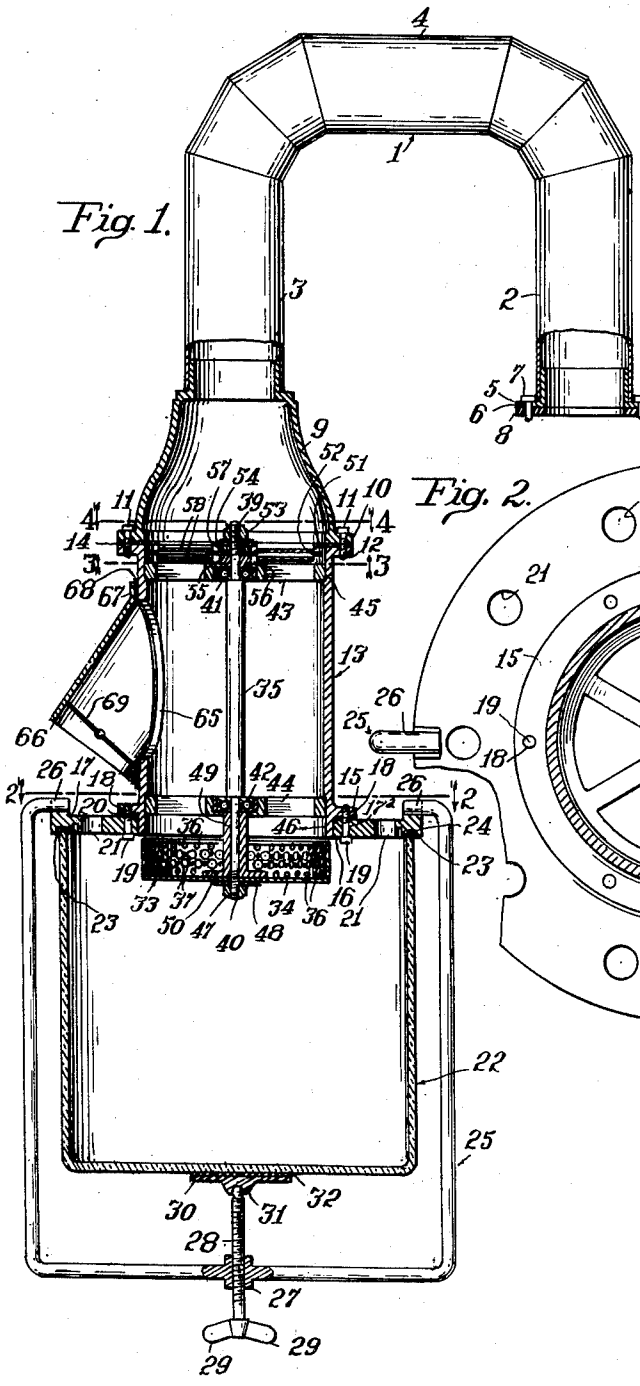


Fig. 3.

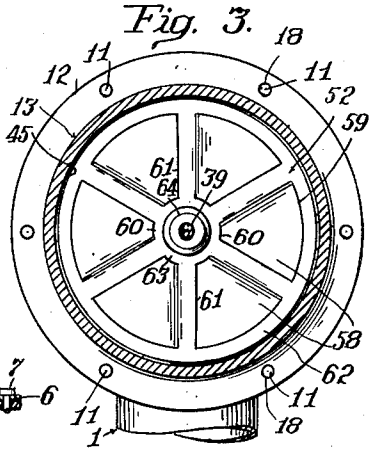
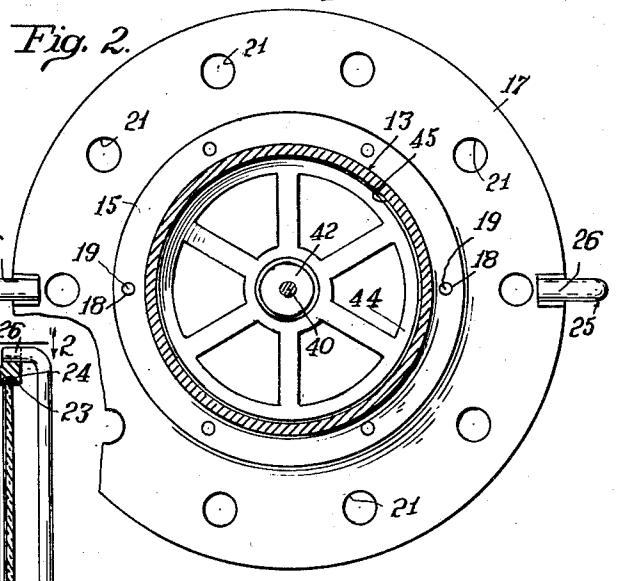


Fig. 2.



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Fig. 4.

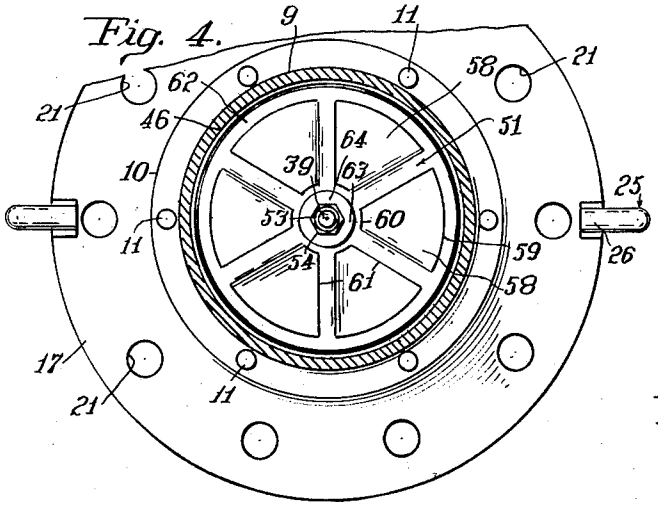


Fig. 5.

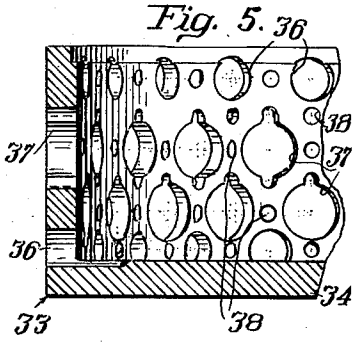


Fig. 6.

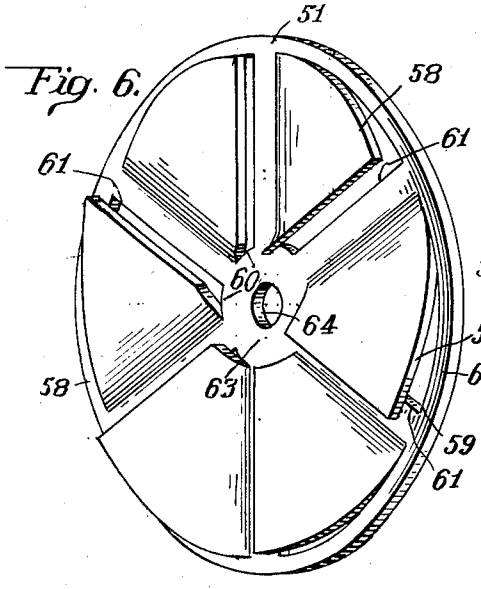


Fig. 7.

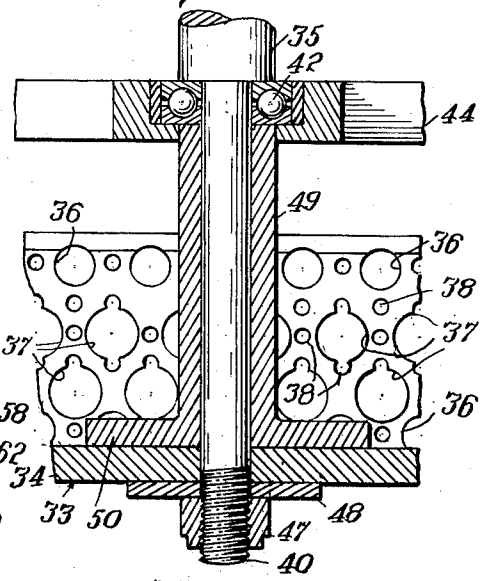


Fig. 8.

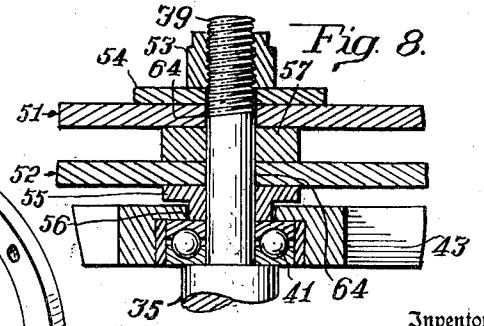
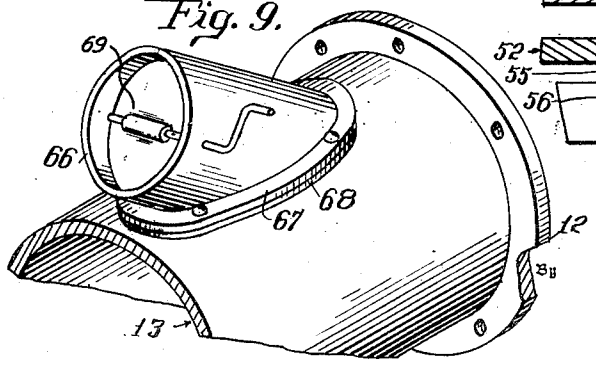


Fig. 9.



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2,653,016

AIR CLEANING DEVICE

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8 Claims. (Cl. 261—35)

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The invention relates to an air cleaning device for engines of the diesel type and all other types of fuel driven motors requiring an air intake, and for analogous purposes.

An object of the present invention is to provide a simple practical and comparatively inexpensive air cleaning device of strong and sturdy construction, designed particularly for use on diesel engines, and having a combined reservoir and sediment bowl and provided with an air and liquid separator capable of being rotated approximately 7000 R. P. M. by the suction of a diesel engine and with only approximately one gallon of water or oil of being 99.5% effective in trapping harmful dirt and dust.

A further object of the invention is to provide an air cleaner of this character having a combined liquid reservoir and sediment bowl through which the air to be cleaned passes, and equipped with a rotary air and liquid separator actuated by the suction of the diesel engine and adapted to separate air and liquid and permit the scavenged clean air to pass into the manifold of the engine and at the same time, through centrifugal action, prevent the liquid from entering the engine and at the same time supplying to the engine vapor to assist in supporting combustion.

Another object of the invention is to provide an air cleaner in which only liquid will be employed for cleaning the air and removing therefrom dust, dirt and other foreign matter, thereby dispensing with fibrous or analogous filtering elements or mediums which interfere with the free passage of air to the intake manifold of the engine.

Another object of the invention is to provide an air cleaning device for internal combustion engines which will not require professional care and in which there is no costly material to be thrown away when servicing is required and which in servicing it will only be necessary to pour the air cleaning liquid out of the combined reservoir and sediment bowl and, without washing or drying, simply refill the bowl with liquid to condition it for use.

Also it is an object of the invention to provide an air cleaning device which, when water is used as an air cleaning medium, will trap the material substances of odors and other foreign matter so fine that they cannot be seen even with an ordinary microscope.

It is also an object of the invention to provide an air cleaning device adapted for the use of water as a cleaning medium and having a combined reservoir and sediment bowl arranged so

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that as the temperature of the engine rises the temperature of the water in the combined reservoir and sediment bowl will be correspondingly elevated and cause a vapor which will pass through the air and water separator and through the intake manifold of the engine and assist in supporting combustion and contribute to an increase in horsepower, cooler operation and less carbon.

A further object of the invention is to provide an air cleaning device, simple in construction and easy to manufacture and which will enable the air cleaner to be put on the market at a reasonable price and provide for longer life and better performance of internal combustion engines.

With the above and other objects in view, the invention consists in the construction and novel combination and arrangement of parts hereinafter fully described, illustrated in the accompanying drawings and pointed out in the claims hereto appended, it being understood that various changes in the form, proportions, and minor details of construction, within the scope of the claims, may be resorted to without departing from the spirit or sacrificing any of the advantages of the invention.

In the drawings:

Fig. 1 is a central vertical sectional view of an air cleaning device constructed in accordance with the present invention;

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

Fig. 3 is a transverse sectional view taken on the line 3—3 of Fig. 1;

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 1;

Fig. 5 is an enlarged transverse sectional view of the rotary air and liquid separator;

Fig. 6 is a perspective view of one of the fans;

Fig. 7 is an enlarged detail sectional view taken longitudinally of the lower portion of the vertical shaft illustrating the manner of mounting the air and liquid distributor, the shaft being shown in elevation;

Fig. 8 is a similar view taken longitudinally of the upper portion of the vertical shaft illustrating the manner of mounting the fans;

Fig. 9 is a detail perspective view of the tubular lateral air inlet.

In the accompanying drawings, in which is illustrated one embodiment of the invention, the air cleaning device, which is designed for use on a diesel engine, but which is adapted for cleaning air for internal combustion engines of any other type and for analogous purposes such as air con-

ditioning systems and the like, comprises in its construction an inverted approximately U-shaped conduit 1 having vertical legs 2 and 3 and a top connecting portion 4. The lower end of the leg 2 is provided with an exterior annular flange 5 having a plurality of openings 6 adapted to receive bolts 7 for securing the conduit to the intake of the manifold of a diesel engine (not shown), and in practice a gasket 8 will be interposed between the flange 5 and the intake of the manifold. The conduit 1 may be constructed of any suitable metal such as aluminum, and a reducing section 9 is rigidly connected to the lower end of the leg 3 of the conduit 1 and flares outwardly therefrom and is provided at its lower end with an annular flange 10 which is secured by bolts 11 to an annular flange 12 of the upper end of a cylindrical housing 13, a suitable gasket 14 being interposed between the flanges 10 and 12.

The cylindrical housing 13 is vertical and concentric with the leg 3 of the conduit 1 and constitutes a portion of an air conduit extending from the bowl to the intake manifold of the engine, and said cylindrical housing is provided at its lower end with an annular flange 15 provided at its lower face with an annular recess 16 within which is secured a mounting plate 17 consisting of a ring provided near its inner periphery with a plurality of spaced holes 17 registering with corresponding holes 18 in the flange 15 and receiving bolts 19 which secure the mounting plate 17 in a horizontal position to the lower end of the cylindrical housing. The bolts or screws employed in the cleaning device are preferably provided with socketed heads adapted to be engaged by a suitable wrench, but any other suitable fastening devices may, of course, be employed and a gasket 20 is preferably interposed between the mounting plate and the flange 15 of the cylindrical housing.

The mounting plate, which may be constructed of any suitable metal, is provided with air inlet openings 21 which communicate with a combined reservoir and sediment bowl 22 adapted to contain a suitable liquid such as water or oil for cleaning air entering the air inlet openings 21 and passing therefrom through the cylindrical housing and the conduit 1 into the manifold of a diesel or other internal combustion engine. The bowl 22 is preferably constructed of glass and has a capacity of one gallon, which has been found sufficient, and the edge of the open top of the bowl is fitted against a foam rubber gasket 23 inset in the mounting plate 15 in an annular groove 24 located adjacent the outer periphery of the mounting plate.

The bowl 22 is supported and secured to the mounting plate by a clamp 25 consisting of a substantially rectangular frame constructed of suitable metal and composed of spaced vertical sides and a lower horizontal connecting portion and provided at the top with inwardly extending terminal arms 26 which rest upon the upper face of the mounting plate adjacent the outer periphery thereof. The bowl supporting frame preferably consists of a round bar bent into rectangular formation, but it may be constructed in any other suitable manner and the lower horizontal portion is provided with a centrally arranged internally threaded vertical sleeve 27 rigidly mounted in the horizontal connecting portion of the frame in any desired manner and receiving a vertical screw 28. The screw 28, which is provided at its lower end with wings 29 carries at its upper end a head 30 connected by

a ball and socket connection 31 with the upper end of the screw and provided with a cushion or pad 32 of foam rubber or any other suitable material for seating and engaging the bottom of the bowl 22. The screw is adapted to be readily manipulated by the wings 29 and the ball and socket connection provides a swivel joint and also enables the head 30 to adjust itself to the bottom of the bowl. The means for suspending the bowl from the mounting plate will enable the bowl to be readily attached to the mounting plate and to be readily removed therefrom so that when servicing is necessary it may be readily removed and the liquid poured therefrom and fresh liquid supplied thereto. Thus the air cleaner does not require professional care in such servicing and it is not necessary to discard an expensive filtering medium such as fibrous material which would also interfere with the free passage of air into the bowl and from the bowl to the manifold of the engine. The mounting ring is provided with twelve equally spaced $\frac{11}{16}$ inch intake holes 21 which have been found to give satisfactory results, but the size and number of the air inlet holes or openings 21 may be varied, as will be readily understood.

The air passing through the bowl 22 is cleaned by a rotary air and liquid separator 33 acting in conjunction with liquid within the bowl 22. The separator 13 consists of a cylinder arranged horizontally within the top of the bowl 22, which in practice is about half filled with water or other liquid, but the amount of liquid may be varied. Under normal operational conditions the rotary cylindrical separator 33 is not submerged in the liquid contained within the bowl 22 but is located above the level of the liquid therein. When in operation air is pulled down through the intake openings 21 at such a terriffic force, at the rate of approximately 100 cubic feet of air per minute per cylinder, by the suction of the engine, that the water is forced up around the water separator, causing a churning motion of the liquid and also causing liquid and air to be in constant contact with the separator 33 while the same is rotating, the rotary separator being entirely enveloped and submerged in the liquid of the bowl. During the operation, dust particles pulled through the intake openings 21 are first saturated with the liquid in the bowl 22 and then becomes as heavy as the saturating liquid. When this action has taken place, the air is then freed of both liquid and dust particles by the action of the rotary air and liquid separator 33. The cylinder is concentric with the lower end of the cylindrical housing and is of the same diameter as the cylindrical housing and it is open at the top and closed at the bottom by a head 34 consisting of a disc, preferably formed integrally with the cylinder and carried by the lower end portion of a vertical shaft 35.

The separator 33 is provided adjacent its upper and lower edges with uniformly spaced $\frac{5}{16}$ inch holes 36 arranged in annular series, and the holes of the upper annular series are located opposite the intervals between the holes of the lower annular series. The separator is also provided at the space between the upper and lower annular series of holes 36 with two annular series of $\frac{13}{32}$ inch holes 37, arranged in staggered relation, the holes 37 of one series being arranged opposite the intervals between the holes 37 of the other series. The cylindrical separator is also provided between the holes 36 and 37 with smaller holes or perforations 38. As the cylindrical separator

is closed at the bottom the air is caused to pass through the holes in the vertical walls of the horizontally disposed cylindrical separator and when the latter is rotated by the means hereinafter described, the churning of the liquid resulting from the air entering through the intake openings 21, due to the suction of the engine and the rotary motion of the cylindrical separator, will wash the air and remove therefrom dust, dirt and all foreign matter and even trap the material substances of odor which are so small that they cannot be seen even with an ordinary microscope. Also the centrifugal action of the cylindrical separator will discharge the water radially outwardly from it and separate the water and air and minimize the amount of water entering the cylindrical housing 13 and resulting in the air being more or less heavily laden with moisture. As the temperature of the engine rises the temperature of the liquid within the bowl will be correspondingly elevated and when water is employed as the cleaning medium, vapor will result from such increase in the temperature of the water in the bowl and will pass through the separator into the intake manifold which will mean better combustion with increase in horse power of the engine and cooler operation thereof and less carbon resulting in longer life and better performance of internal combustion engines.

The vertical shaft 35 is provided with reduced upper and lower end portions 39 and 40 which are journaled in upper and lower ball bearings 41 and 42 of upper and lower horizontal spiders 43 and 44 fitted within upper and lower interiorly reduced portions 45 and 46 which form abutment shoulders for positioning the spiders. The lower end portion 40 of the shaft 35 is threaded to receive a castle nut 47 for securing the cylindrical separator to the lower end portion of the shaft 35, a washer 48 being preferably interposed between the nut and the head or disc of the cylindrical separator. The cylindrical separator is maintained in proper position with relation to the open lower end of the cylindrical housing by a spacer sleeve 49 interposed between the central hub portion of the lower spider 44 and the disc or head of the cylindrical separator and provided at the lower end with an annular disc-like flange 50 which fits against the upper face of the head of the cylindrical separator.

The cylindrical separator is rotated by the suction of the diesel engine operating on a pair of closely spaced upper and lower turbine wheels 51 and 52 which are retained on the upper reduced end portion 39 of the vertical shaft 35 by a castle nut 53, a washer 54 being preferably interposed between the castle nut and the upper turbine wheel 51. The upper and lower turbine wheels have their peripheries arranged adjacent to but closely spaced from the walls of the cylindrical housing 13. The lower turbine wheel is adjacent a spacer sleeve 55 provided at the top with a peripheral flange 56 which fits against the hub portion of the upper spider and the upper turbine wheel is spaced from the lower turbine wheel by a washer 57.

Each turbine wheel preferably consists of a disc of aluminum or other suitable material provided with substantially sector shaped blades 58 formed by inner and outer arcuate slits 59 and 60 and a connecting radial slit 61. The outer arcuate slits are arranged adjacent the periphery of the disc and leave a narrow rim portion 62 adjacent the outer edges of the blades 58. The inner arcuate slits 60, which are short, are spaced from the

center of the disc to leave a hub portion 63 which is provided with a central opening 64 for the passage of the vertical shaft. The blades are slightly deflected and set at an angle so that the current of air created by the suction of a diesel engine will impart rotary movement to the turbine wheels and to the shaft and the cylindrical separator carried by the shaft. It has been found by experience that with blades of this construction the suction of a diesel engine will rotate the cylindrical separator approximately 7000 R. P. M. which will result in the air cleaner being substantially 99.5% effective in trapping harmful dirt and dust and other foreign matter, and that the speed of the cylindrical separator and the centrifugal action of the same on water will minimize the amount of water entering the engine. When the air cleaner is applied to internal combustion engines other than the diesel type, it is necessary to positively rotate the separator to attain the necessary speed of rotation and any suitable means may be employed for this purpose.

The cylindrical housing is provided at one side with an air opening 65 of approximately elliptical form and secured over the opening is a downwardly inclined tubular air inlet 66 tapered at its inner end and provided thereat with an attaching flange 67 secured by bolts or other suitable fastening devices to the cylindrical housing, a suitable gasket 68 being interposed between the attaching flange and the marginal portion of the wall of the cylindrical housing surrounding the substantially elliptical air inlet opening. A butterfly valve 69 of conventional form mounted in the tubular air inlet 66 at the outer end thereof and adapted to be operated manually, or by any other suitable means, for opening and closing the same. Previous to starting the engine, the butterfly valve is turned to open position and after the engine is started and the separator 33 has attained normal speed the butterfly valve is operated to close the tubular air inlet 66 and cause air to be drawn downwardly through the inlet openings 21 and produce the air cleaning operation heretofore described. The turbine wheels which extend across the upper end of the cylindrical housing constitute a barrier for moisture and insure vaporization of moisture passing to the intake manifold of the engine.

We claim:

1. An air cleaning device for internal combustion engines including a combined liquid reservoir and sediment bowl for containing air cleaning liquid, an air conduit extending from the top of the bowl for connection to the air intake of an engine manifold, air inlet means located at the top of the bowl exteriorly of said conduit to one side thereof providing for the admission of air into the bowl, and a high speed rotary air and liquid separator arranged within the upper portion of the bowl, said separator being of general cup-shaped formation closed at its bottom part and having its side wall provided with a multiplicity of holes for the passage of air therethrough, said separator having its open top located adjacent to and communicating with said conduit, the high velocity air entering the bowl through said inlet means at the top of the bowl acting to churn up liquid in the bowl and force the same upwardly to envelope and submerge the rotary separator, the dust particles in the air entering said air inlet means first becoming saturated with liquid in the bowl and then becoming as heavy as the liquid, the air being then freed of both liquid and dust particles by the rotary

separator which acts to discharge the liquid radially outwardly therefrom, the cleaned air passing into the separator through the holes in the side wall thereof, the interior of the bowl being entirely free from obstruction between said air inlet means and said rotary separator to provide for free passage of air from said inlet means to the rotary separator except for the churned liquid within the bowl.

2. An air cleaning device for internal combustion engines as set forth in claim 1 and in which the air and liquid separator is of cylindrical form.

3. An air cleaning device for internal combustion engines as set forth in claim 2 and in which the holes in the side wall of the separator are arranged in uniformly spaced annular series.

4. An air cleaning device for internal combustion engines as set forth in claim 2 and in which the holes in the side wall of the separator are arranged in annular series of different sizes and there are small perforations between the holes.

5. An air cleaning device for internal combustion engines including a combined liquid reservoir and sediment bowl for containing air cleaning liquid, a mounting plate fitting on the top of the bowl, means detachably clamping the bowl to the mounting plate, an air conduit connected with an air outlet opening in the mounting plate substantially centrally thereof for connection to the air intake of an engine manifold, said mounting plate having a ring of air inlets located about said central air outlet, and a high speed air and liquid separator arranged within the upper portion of the bowl, said separator being of general cup-shaped formation closed at its bottom part and having its side wall provided with a multiplicity of holes for the passage of air therethrough, said separator having its open top located adjacent to and communicating with said central air outlet in the mounting plate, the high velocity air entering the bowl through said air inlets in the mounting plate acting to churn up liquid in the bowl and force the same upwardly to envelope and submerge the rotary separator, the dust particles in the air entering the air inlets first becoming saturated with liquid in the bowl and then becoming as heavy as the liquid, the air being then freed of both liquid and dust particles by the rotary separator which acts to discharge the liquid radially outwardly therefrom, the cleaned air passing into the separator through the holes in the side wall thereof, the interior of the bowl being entirely free from obstruction between said air inlets in the mounting plate and said rotary separator to provide for free passage of air from said inlets to the rotary separator except for the churned liquid within the bowl.

6. An air cleaning device for internal combustion engines including a combined liquid reservoir and sediment bowl for containing air cleaning liquid, an air conduit for connection to the intake

of an engine manifold, said air conduit having a vertical housing extending up from the top of and in communication with said bowl, air inlets to the top of the bowl exteriorly of said housing, a vertical shaft extending through the housing, means carried by the housing for mounting the shaft for rotary movement, a high speed rotary air and liquid separator mounted on said shaft at the lower end thereof within the bowl, said separator being of general cup-shaped formation closed at its bottom part and having its side wall provided with a multiplicity of holes for the passage of air therethrough, said separator having its open top located adjacent to and communicating with the lower end of said housing, and a turbine wheel mounted on said shaft above said rotary separator operable by suction from the intake of the engine manifold for rotating the shaft and separator, the high velocity air entering the bowl through the inlets at the top of the bowl acting to churn up liquid in the bowl and force the same upwardly to envelope and submerge the rotary separator, the dust particles in the air entering said air inlets first becoming saturated with liquid and then becoming as heavy as the liquid, the air being then freed of both liquid and dust particles by the rotary separator which acts to discharge the liquid radially outwardly therefrom, the cleaned air passing into the separator through the holes in the side wall thereof, the interior of the bowl being entirely free from obstruction between said air inlets and said rotary separator to provide for free passage of air from said air inlets to said rotary separator except for the churned liquid within the bowl.

7. An air cleaning device for internal combustion engines as set forth in claim 6 and in which said turbine wheel consists of a disk provided at intervals with inner and outer arcuate slots and a radial connecting slot and having the partially severed portions of the disk deflected and providing blades.

8. An air cleaning device for internal combustion engines as set forth in claim 6 and in which said housing has an air inlet port in the side thereof, and there is means for closing said last mentioned inlet port after the separator has attained normal speed.

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