June 30, 1942. H. G. KAMRATH 2,287,806

AIR CLEANER AND SILENCER ASSEMBLY

Original Filed Sept. 25, 1935 3 Sheets-Sheet 1

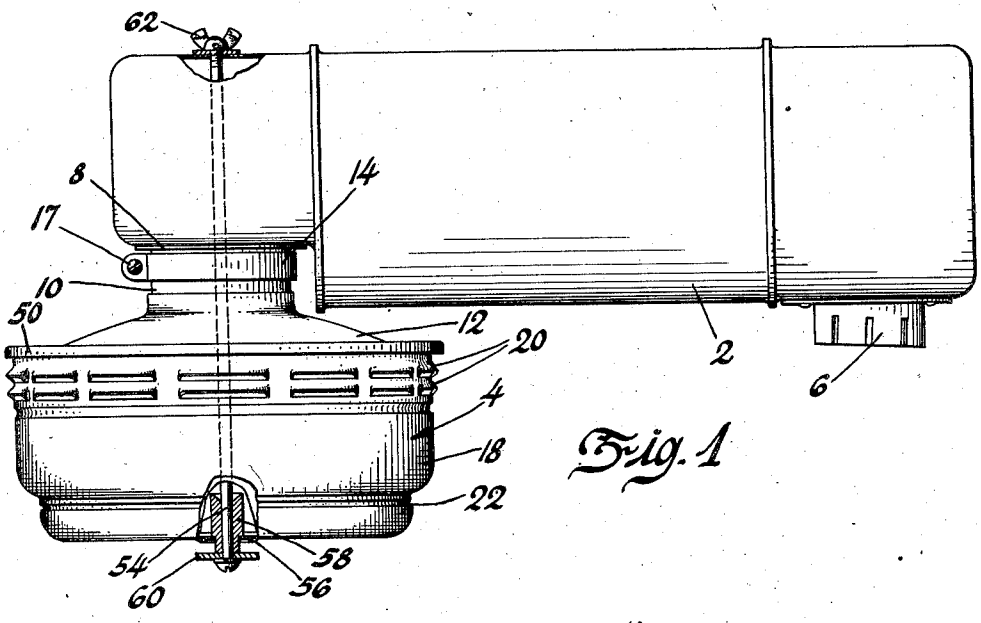


Fig. 1

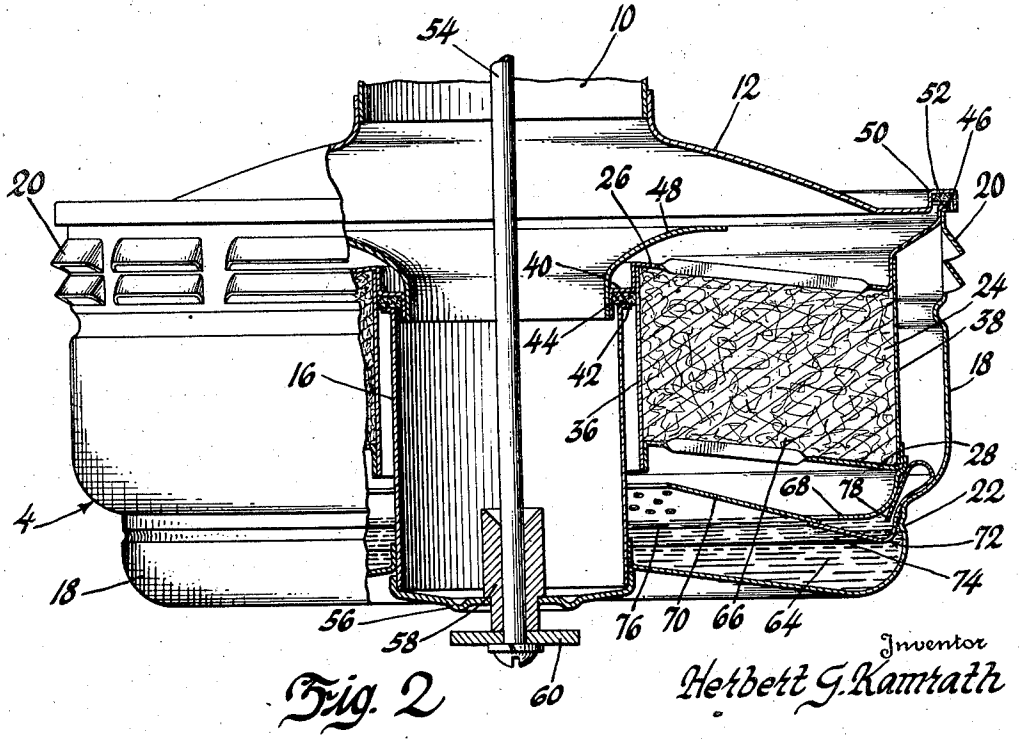


Fig. 2

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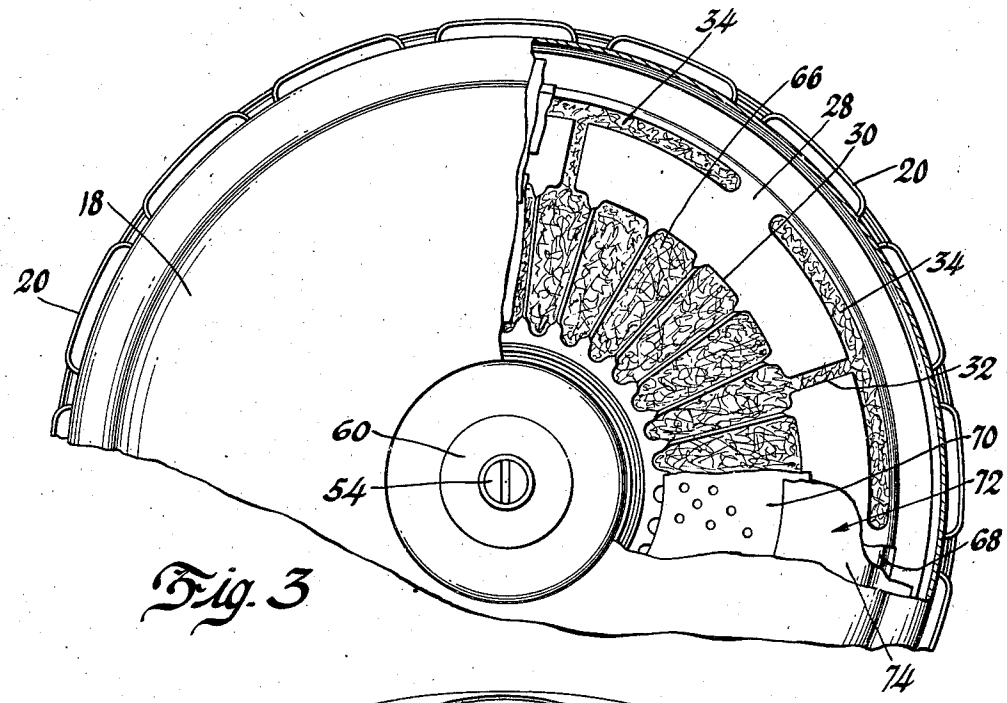


Fig. 3

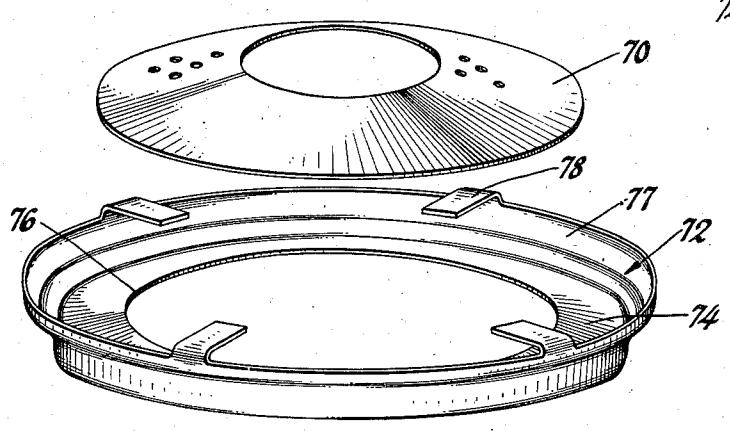


Fig. 4

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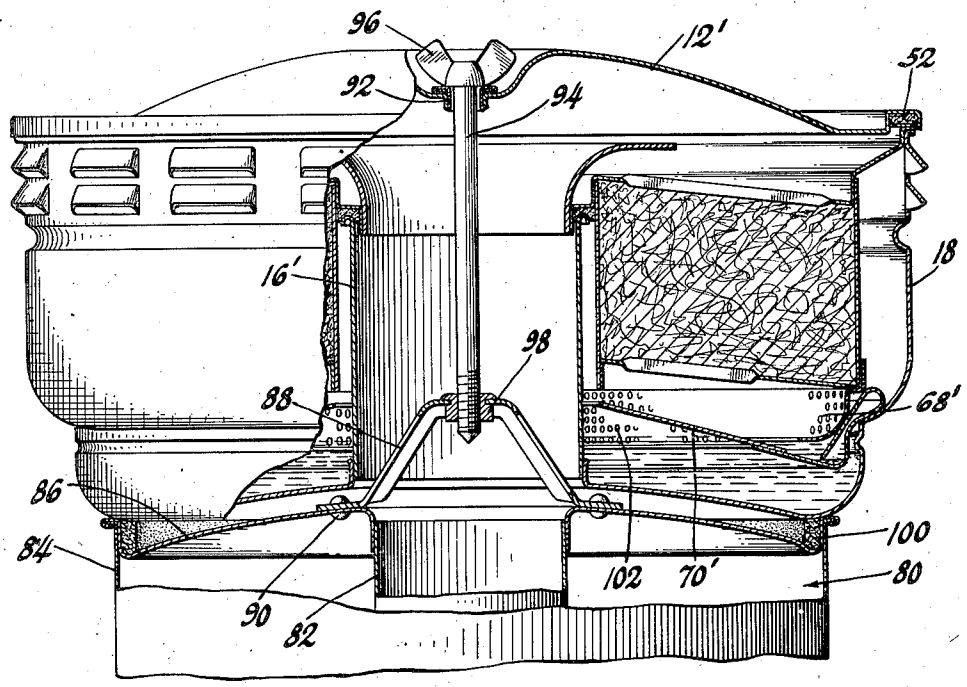


Fig. 5

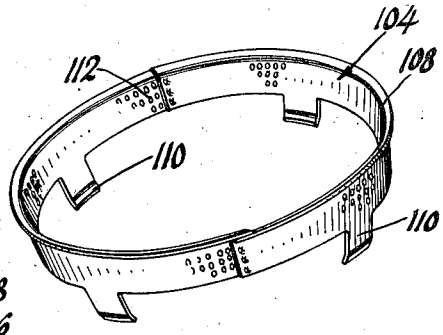


Fig. 7

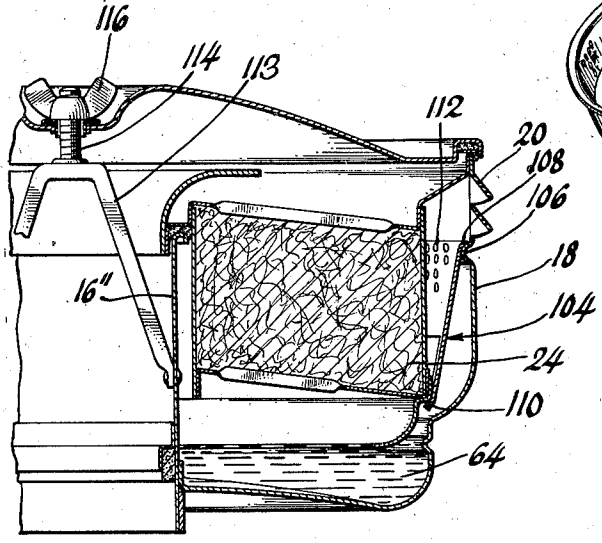


Fig. 6

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UNITED STATES PATENT OFFICE

2,287,806

AIR CLEANER AND SILENCER ASSEMBLY

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Application September 25, 1935, Serial No. 41,999
Renewed July 18, 1940

25 Claims. (Cl. 183—15)

This invention relates to apparatus for removing foreign matter from gases and to assemblies of such apparatus with apparatus for attenuating sound waves in the gases and, more particularly, to air cleaners and air cleaner and silencer assemblies for use in conjunction with carburetors of internal combustion engines.

In one of its aspects, the invention resides in air cleaners which are particularly adapted for use in localities in which there is in the air a large amount of foreign matter which must be removed before the air is fit for introduction into an internal combustion engine. Such air cleaners must, without offering undue resistance to the passage of air, be capable of removing large quantities of foreign matter from it over extended periods of time without any attention or care. An object of this invention in this respect is to provide air cleaners with the mentioned characteristics and capabilities which may quickly and easily be disassembled and reassembled when it becomes necessary to clean them.

More specifically, in the aspect which has been discussed, the invention resides in liquid bath type air cleaners and has for an object to provide air cleaners of this type in which there may be maintained a supply of liquid adequate to insure that the filter will be kept wetted and washed and an effective settling pool for foreign matter removed from the air by the air cleaners without danger of liquid being carried beyond the air cleaners by the air or lost by weltering.

In the other of its aspects, the invention resides in assemblies of air cleaners and silencers and has for its principal object to provide assemblies of liquid bath type air cleaners and resonator type silencers which are efficient, compact and neat in appearance.

For a better understanding of the nature and objects of this invention, reference is made to the following specification wherein there are described the embodiments of the invention which are illustrated in the accompanying drawings, in which:

Fig. 1 is a side elevation of an intake silencer and air cleaner assembly with parts broken away and in section.

Fig. 2 is an enlarged view, partly in elevation and partly in section, of the air cleaner included in the assembly shown in Figure 1.

Fig. 3 is a fragmentary bottom plan view of the air cleaner shown in the preceding figures with parts broken away.

Fig. 4 is an exploded perspective view of the parts of a baffle which is incorporated in the air cleaner shown in the preceding figures.

Fig. 5 is a view, partly in elevation and partly in section, of another intake silencer and air cleaner assembly.

Fig. 6 is a fragmentary vertical section through a modified form of the air cleaner shown in the preceding figures.

Fig. 7 is a perspective view of a baffle incorporated in the air cleaner shown in Fig. 6.

An assembly of an intake silencer 2 of the resonator type and an air cleaner designated generally by the reference character 4 is shown in Fig. 1 of the drawings. At the end opposite that attached to the air cleaner, the silencer is provided with a circular split flange 6 for attachment to the air intake tube of a downdraft carburetor. The left-hand end of the silencer has an opening in its lower face around which is secured a split flange 8 into which fits a short hollow cylinder 10 which is secured in any suitable manner to the air cleaner cover 12. Around the split flange 8 extends a split clamping ring 14 which is pulled by a screw 17 tightly around the split flange to clamp it snugly around the cylinder 10.

The air cleaner 4 has, at its center, a hollow cylinder 16 to which is secured, near its lower extremity, a cup-shaped outer casing 18, the cylinder projecting through the base of the casing for a short distance. The upper portion of the casing has a series of air louvres 20, throughout its circumference, for the intake of air. Near its lower part the vertical side wall of the casing is stepped inwardly as indicated at 22 for a purpose which will become evident as the description proceeds.

Disposed within the casing 18, around the cylinder 16, but spaced from both the cylinder and the side wall of the casing, is a toroidal filter member designated generally at 24. The filter member 24 consists of an annular shell filled with a suitable filter medium 66. The lower wall 28 of the filter member has in it, as Figure 3 shows most clearly, a circumferential series of radial openings 30 which extend radially from near its inner edge to about half way to its outer edge, certain of these openings 30 being extended by slots 32 farther toward the outer edge of the wall 28 to join with arcuate openings 34 near the outer edge of the wall 28. The upper wall 26 of the filter member has in it a circumferential series of radial openings which are similar to the openings 30 but extend from near the inner to near the outer edge of the wall. These upper

and lower walls of the filter member are connected by two cylindrical members 36 and 38 which form the inner and outer walls of the filter member.

The upper wall of the filter member is extended inwardly beyond the inner wall 36 to provide a flange 40 which is seated on an outturned flange on the upper end of the tubular member 16 through the intermediary of a sealing gasket 44 and is extended outwardly and upwardly beyond the outer wall 38 of the filter member to form a flange 46 whose outer edge is seated on the upper edge of the side wall of the casing 18. Thus the filter member is supported at its outer edge by the casing 18 and at its inner edge by the cylinder 16 with its lower wall 28 well above the bottom of the casing 18.

Secured within the central opening in the upper wall 26 of the filter member is a member 48 which is flared outwardly above the upper wall of the filter member to a point well beyond the inner edges of the slots in it. The member 48 acts as a baffle to prevent the air passing through the air cleaner from carrying liquid beyond it and also serves to prevent the air passing through the inner portion of the filter member to the exclusion of the rest of it.

The cover portion 12 of the air cleaner has a peripheral bead 50 formed therein which carries a sealing gasket 52 which is seated on the outer edge of the flange 46 on the upper wall of the filter member. Thus when the air cleaner is totally assembled with the top in place and the same is applied to the intake silencer 2, as described in the earlier part of the specification, the whole is clamped together by a long rod 54 which extends through the upper wall of the intake silencer 2 and down through the central tube 16 of the air cleaner as best shown in Fig. 2. The lower end of the cylinder 16 which, as has been said, projects slightly through the bottom of the casing 18 is closed by a circular cap 56 in which is secured a member 58 through which the rod 54 also extends. Between the lower end of the member 58 and the head on the lower end of the rod 54 is clamped one end of a bracket 60 for supporting the air cleaner and silencer assembly. The opposite end of the rod 54, which extends through the upper wall of the intake silencer 2, is threaded and a thumb nut 62 is applied thereto to pull the parts tightly together.

Before the assembly shown in Figure 1 is put into use, the reservoir defined by the center tube 16 and the casing 18 of the air cleaner is filled with oil or some other suitable liquid 64 to about the level indicated in the drawing and the filter material 66 is wetted with the same liquid. When the assembly is in use, air enters it through the louvres 20, passes downwardly through the passage between the outer wall 38 of the filter member and the side wall of the casing 18, around the lower outer edge of the filter member and into the interior of the filter member through the openings 30. The air then passes through the filter material 66, out of the filter member through the openings in its upper wall 26 whence it passes through the tubular member 10 into the silencer 2 and thence through the opening encircled by the flange 6 into the carburetor and cylinders of the engine on which the assembly is installed. In the course of its travel from the passage between the outer wall of the filter member and the side wall of the casing into the interior of the filter member, the air strikes the surface of the oil in the reservoir, deposits some of the foreign matter carried by it in the oil and picks up some of the oil and carries it with it into the filter material. The foreign matter which remains in the air and the oil picked up by the air are extracted from the air by the filter material and, consequently, the air which leaves the filter member is free of foreign matter and oil. The silencer 2, of course, suppresses the intake noise of the engine on which the assembly is installed and, thus, the assembly shown in Figure 1 cleans the air which enters the engine and eliminates its intake noise.

The oil which is carried into the filter member by the air is continuously returned to the reservoir through the openings 34, carrying with it the foreign matter extracted from the air by the filter material. This foreign matter settles to the bottom of the reservoir and is thus removed from the field of action. Thus while the air cleaner is in use the filter material is continuously washed and kept wetted and the foreign matter extracted from the air by the air cleaner disposed of.

To the lower outer edge of the filter member there is suitably secured a baffle 68 which curves downwardly to a point opposite the edge of the step in the side wall of the casing 18 and then inwardly to a point well beyond the openings 34 in the lower wall of the filter member. The baffle 68 has several functions. It reduces the cross sectional area of the passage through which air travels from the passage between the outer wall of the filter member and the side wall of the casing 18 into the interior of the filter member and thus increases the rate of flow of air and reduces the pressure at this point. The increase in rate of flow of air has the effect of increasing the force with which the air impinges against the surface of the oil in the reservoir and, consequently, the amount of dirt deposited by the air in the reservoir and the amount of oil picked up by the air. The reduction in pressure has the effect of increasing the rate of return of oil from the filter member to the reservoir through the openings 34. The baffle 68 also serves to shield the openings 34 from the entrance of air and thus to increase their efficiency as paths for the return of oil from the filter member to the reservoir.

Since it is desired to use the air cleaner under varying conditions and with various types and sizes of motors, it is advisable to provide some means for limiting and changing the action of the air and the oil and air in the various parts of the air cleaner. If the air cleaner is to be used on an exceedingly large motor, the velocity of the air flow will be very high and too much of the oil in the sump will be carried up into the filtering material. Also, if the air cleaner is to be used on a truck over exceedingly rough ground, it might be possible for some of the oil in the sump to be thrown out through the air intake louvers due to mechanical vibration.

In order to overcome these difficulties and to give a more flexible unit to be used with various installations, a baffle has been provided which may be applied to the unit already described or omitted depending on the installations. This baffle consists of a member 72 which is imperforate and a member 70 which is riddled with perforations. The member 72 is ring-like in form and angle-shaped in cross section with spring fingers 78 projecting from the upper edge of its steeply upwardly and outwardly inclined wall. The member 70 is in the form of a gently in-

clined frusto-cone and has its outer edge suitably secured to the inner edge 76 of the gently upwardly and inwardly inclined wall of the member 72.

The baffle 72—70 is disposed within the casing 18 around the center tube 16 and between the filter member and the bottom of the casing with the steeply upwardly and outwardly inclined wall of the member 72 seated on the riser of the step in the side wall of the casing and the gently upwardly and inwardly inclined wall of the member 72 below the static level of the liquid in the reservoir. The baffle 72—70 is held in this position by engagement of the baffle 68 with the spring fingers 78.

The baffle 72—70 divides the oil in the reservoir into two portions—one above and the other below the baffle—shields the portion of the oil below it from the air traveling through the air cleaner and also inhibits weltering of the oil in the reservoir. The portion of the oil below the baffle constitutes a pool into which foreign matter extracted from the air by the air cleaner may settle out of reach of the air traveling through the air cleaner. The supply of oil above the baffle is renewed from the portion of the oil below the baffle by flow over the inner edge of the member 72 and by return of oil from the filter member through the openings 34 and over the baffle 68, beyond which the gently upwardly and inwardly inclined wall of the member 72 projects. Only from the portion of the oil above the baffle can the air traveling through the air cleaner pick up oil and, consequently, the possibility of the air picking up too much oil is eliminated.

In Fig. 5 is shown an assembly of a liquid bath type air cleaner and a resonator type silencer in which the air cleaner is supported vertically upon the end of the intake silencer instead of in the manner set forth in Fig. 1. In this case the upper end of the intake silencer is shown at 80 having a central tube 82 concentric within an outer shell 84. The two are connected together at the upper end of the silencer by an annular plate 86, the edges being flanged together to form an interconnection between the plate 86 and the outer shell 84 and the center tube 82 being connected with the plate 86 by welding. This plate 86 also supports, above the cylinder 82, an inverted U-shaped bracket 88 which is connected thereto by rivets 90 at the ends thereof. The construction of the air cleaner as a whole in this instance is substantially the same as that set forth in the previous modification with these exceptions: the lower end of the center tube 16' does not extend through the base of the casing 18; there is no air outlet opening in the cover 12'; the lower end of the center tube 16' is open; and the baffle 68' which corresponds to the baffle 68 is riddled with perforations whose effect is to reduce the velocity of travel of air from the passage between the outer wall of the filter member and the side wall of the casing 18 into the filter member. Further reduction of the velocity of travel of air at this point, which may be desirable if the air cleaner is to be used on an engine which requires a very large quantity of air, may, of course, be effected by complete elimination of the baffle.

The air cleaner is seated on the upper end of the silencer with its center tube aligned with the center tube of the silencer through the intermediary of a gasket 100 which serves to prevent air leaking into the assembly between the top of the silencer and the bottom of the air cleaner. The air cleaner is secured to the silencer and the gasket 100 compressed by an elongated thumbscrew 94 which extends through the cover 12' and the center tube 16' and is threaded into a member 98 carried by the U-shaped bracket 88.

The modification shown in Figure 5 lends itself to a very compact assembly between the intake silencer and cleaner in that the two are concentric and substantially a single unit with no elbow support as shown in the first form.

The assembly shown in Figure 5 was designed for installation on an internal combustion engine equipped with a downdraft carburetor with the lower end of the center tube of the silencer connected to the air intake tube of the carburetor. In general this assembly operates in the same manner as that shown in Figures 1 to 4 and it is, consequently, deemed unnecessary to describe its mode of operation further than to point out that in it air leaves the air cleaner through the center tube 16', instead of through the cover, whence it passes into the upper end of the center tube 82 of the silencer and thence through the center tube of the silencer into the carburetor and cylinders of the engine on which the assembly is installed.

The air cleaner shown in Figs. 6 and 7 differs from that shown in Figure 5 in that the baffle 70' has been eliminated and an annular baffle member 104 which encircles the filter member and is encircled by the side wall of the casing added. The bead 106 which is located just below the air louvres 20 in the side of the casing 18 supports the upper end of the baffle member 104, the latter being slightly flared over, as shown at 108, to rest on top of the bead for support. The baffle then is tapered slightly inward and has a plurality of legs 110 extending downwardly which engage the lower corner of the filter assembly 24 for support on the lower end. The body of the member 104 is perforated, as shown at 112, to allow air passage therethrough.

The air cleaner shown in Figures 6 and 7 does not differ from that shown in Figure 5 except in the mentioned respects, in that the baffle which corresponds to the baffle 68' is imperforate and in that an inverted U-shaped bracket 113 is supported on the inner surface of the cylinder 16'' to secure the top on the casing by a bolt 114 and a wing nut 116. The baffle 104 operates very satisfactorily to prevent any oil splashing from the sump 64 up and out of the annular passage between the filter element and the casing 18. The skeleton construction of the lower end of this baffle also prevents whatever oil passes through these perforations and any dust entering the louvres from accumulating between the baffle and the filter element.

I claim:

1. In an air cleaner, an outer casing, a filter assembly supported thereon but spaced from the casing to form an annular air passage, a baffle comprising a ring shaped member, a truncated dished cone secured to the ring member and a plurality of legs projecting from the ring into the space betwen the filter assembly and the casing to support the baffle below the filter assembly.

2. In an air cleaner, a large drum shaped casing having an oil bath in the base, a central tube supported in the casing, a filter assembly supported between the central tube and the casing and forming with the outer casing an annular air passage through which the air may flow down to

the oil bath, a circular indented bead on the casing adjacent the lower edge of the filter assembly whereby the two form a restricted passage, a circular inwardly curved baffle secured to the filter at this point to direct the air out over the oil bath and a cone shaped baffle having supporting legs extending into the restricted portion for holding it over the oil bath to prevent excessive quantities from being carried up into the filter.

3. An air cleaner comprising, a large drum shaped casing having an oil pool in its base, a central cylindrical tube supported in the center of the casing, an annular filter assembly supported between the two and spaced from the outer casing to form a vertical air passage, and a perforated annular ring baffle supported in the air passage between the side wall of the filter assembly and the side wall of the casing to prevent the oil from splashing out of the base of the casing.

4. In an air cleaner, a large drum shaped casing, a central tube which is connected to and extends upwardly from the bottom of the casing, an annular filter assembly including an annular top plate extending on both its inner and outer edges beyond the body of the assembly, flanges on both the inner and outer edges of the mentioned top plate adapted to engage the upper rim of the tube and the casing, respectively, to support the filter assembly, and a gasket between the top of the tube and the inner flange on the top plate.

5. In an air cleaner, a large drum shaped casing having an oil pool in its base, a central cylindrical tube supported in the center of the casing, an annular filter assembly supported between the two and spaced from the outer casing to form a vertical air passage, and a perforated annular baffle in the shape of a truncated cone supported in the air passage between the side wall of the filter assembly and the side wall of the casing and extending from the casing to the filter assembly.

6 In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines therewith an annular receptacle which constitutes a liquid reservoir, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, and an annular baffle riddled with relatively small perforations which is carried by and depends from the outer wall of the annular filter element and terminates short of the bottom of the generally cup-shaped body.

7. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines therewith an annular receptacle which constitutes a liquid reservoir, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, and an annular baffle which is supported by the generally cup-shaped body between its bottom and the bottom of the annular filter element and extends from the side wall of the generally cup-shaped body toward the generally tubular element with its outer and inner edges above and an intermediate portion of it below the liquid level in the cup-shaped body.

8. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines therewith an annular receptacle, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, and an annular baffle which is interposed between the bottom of the generally cup-shaped body and the bottom of the annular filter element and is seated on the side wall of the former and provided with spring fingers which engage the latter.

9. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines therewith an annular receptacle, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, and a generally frusto-conical baffle riddled with openings which extends between the side wall of the generally cup-shaped body and the side wall of the annular filter element and is provided with spring fingers which maintain it in position.

10. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines therewith an annular receptacle which constitutes a liquid reservoir, a hollow annular member disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, openings in the lower wall of the hollow annular member near its inner and outer edges connected by radially extending openings with smaller dimensions circumferentially of the hollow annular member, and dust-collecting material within the hollow annular member.

11. In an air cleaner and silencer assembly, a silencer which consists of a generally vertically disposed shell, a wall which closes the upper end of the shell, and a generally tubular element which extends through the specified wall and the interior of the shell; an air cleaner which consists of a generally vertically disposed generally cup-shaped body mounted on the upper end of the silencer element, a cover therefor, and a generally tubular element which is connected to the bottom of the generally cup-shaped body and is approximately alined with the first-specified generally tubular element; a sealing gasket which is interposed between the bottom of the generally cup-shaped body of the air cleaner and the upper end wall of the silencer and encircles the duct defined by the specified generally tubular elements, and an element which extends through the cover and the generally tubular element of the air cleaner and is connected to the silencer to compress the gasket and secure the air cleaner and the silencer together.

12. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines with it an annular receptacle which constitutes a liquid reservoir, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, and an annular baffle which is supported by the generally cup-shaped body between its bottom and the bottom of the annular filter element and extends downwardly and then

upwardly from the side wall of the generally cup-shaped body toward the generally tubular element and is imperforate near its outer edge and riddled with relatively small openings inwardly thereof.

13. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines with it an annular receptacle which constitutes a liquid reservoir, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, an annular baffle which is carried by and depends from the outer wall of the annular filter element and is inclined in the direction of the generally tubular element and terminates short of the bottom of the generally cup-shaped body, and an annular baffle which is supported by the generally cup-shaped body between its bottom and the bottom of the annular filter element and extends from the side wall of the generally cup-shaped body toward the generally tubular element with its outer edge above and a portion of it below the liquid level in the generally cup-shaped body.

14. In an air cleaner, a generally cup-shaped body, a generally tubular element which is connected to and extends upwardly from the bottom of the generally cup-shaped body and defines with it an annular receptacle which constitutes a liquid reservoir, an annular filter element disposed within the annular receptacle and spaced from the side and bottom walls of the generally cup-shaped body, a generally frusto-conical baffle riddled with openings which extends between the side wall of the generally cup-shaped body and the side wall of the annular filter element, and an annular baffle which is carried by and depends from the outer wall of the annular filter element and is inclined in the direction of the generally tubular element and terminates short of the bottom of the generally cup-shaped body.

15. In an air cleaner, a generally bowl-shaped member, a generally tubular member which is connected to and extends upwardly from the lower wall of the generally bowl-shaped member and with it defines an annular receptacle which constitutes a liquid reservoir, an annular filter member with air inlet and outlet orifices in its lower and upper walls disposed within the generally bowl-shaped member with its outer side and lower walls spaced from the side and lower walls of the generally bowl-shaped member to define a passage through which air may travel from the atmosphere toward the surface of the liquid in the reservoir and thence into the air inlet orifice in the filter member, the generally bowl-shaped member having in it in the path of travel of air toward the surface of the liquid in the reservoir, an annular shelf which is disposed below the static level of liquid in the reservoir but above the bottom of the generally bowl-shaped member, and a baffle which is riddled with perforations extending inwardly and upwardly from the inner edge of the shelf toward the center of the air cleaner.

16. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, the generally bowl-shaped member having in it, in the path of travel of air toward the surface of the liquid in the reservoir, a circular shelf which is disposed below the static level of liquid in the reservoir but above the bottom of the generally bowl-shaped member, and a baffle which is riddled with perforations extending upwardly and in the direction of travel of air through the air cleaner from the edge of the shelf.

17. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, and a circular baffle which extends upwardly in the direction of travel of air through the air cleaner from a point below to a point above the static level of liquid in the reservoir and has an imperforate portion below and a portion riddled with perforations above the static level of liquid in the reservoir.

18. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, the generally cylindrical member having a portion through which air may pass from the first mentioned into the last mentioned passage projecting below the last mentioned means.

19. In an air cleaner, a generally bowl-shaped member which constitutes a liquid reservoir, a filter member with air inlet and outlet orifices in it disposed within the generally bowl-shaped member with its outer side and lower walls spaced from the side and lower walls of the generally bowl-shaped member to define a passage through which air may travel from the atmosphere toward the surface of the liquid in the reservoir and thence into the air inlet orifice in the filter member, and means through which air may pass disposed in the mentioned passage between the side wall of the filter member and the side wall of the generally bowl-shaped member to prevent liquid splashing out of the reservoir therethrough.

20. In an air cleaner and silencer assembly, a generally vertically disposed shell which constitutes an element of a silencer, a generally bowl-shaped member which constitutes an element of an air cleaner and a cover for the upper end of

the generally vertically disposed shell mounted on the generally vertically disposed shell at its periphery and secured to it, a duct through which air is conducted from the air cleaner into the generally vertically disposed shell and through the generally vertically disposed shell including a generally tubular member which is connected to and extends upwardly from the lower wall of the generally bowl-shaped member and with it defines an annular receptacle which constitutes a liquid reservoir, an annular filter member with air inlet and outlet orifices in it disposed within the generally bowl-shaped member with its outer side and lower walls spaced from the side and lower walls of the generally bowl-shaped member to define a passage through which air may travel from the atmosphere into the air inlet orifice in the filter member, a cover for the filter member which constitutes a wall of a passage through which air may travel from the air outlet orifice in the filter member into the upper end of the generally tubular member, and means for securing the filter member and cover to the generally bowl-shaped member.

21. In an air cleaner, a generally bowl-shaped member, a generally tubular member which is connected to and extends upwardly from the lower wall of the generally bowl-shaped member and with it defines an annular receptacle which constitutes a liquid reservoir, and an annular filter member with air inlet and outlet orifices in its lower and upper walls disposed within the generally bowl-shaped member with its outer side and lower walls spaced from the side and lower walls of the generally bowl-shaped member to define a passage through which air may travel from the atmosphere toward the surface of the liquid in the reservoir and thence into the air inlet orifice in the filter member, the generally bowl-shaped member having in it in the path of travel of air toward the surface of the liquid in the reservoir an imperforate annular shelf which is disposed below the static level of liquid in the reservoir but above the bottom of the generally bowl-shaped member.

22. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, and means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, the generally bowl-shaped member having in it in the path of travel of air toward the surface of the liquid in the reservoir an imperforate circular shelf which is disposed below the static level of liquid in the reservoir but above the bottom of the generally bowl-shaped member.

23. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, the generally bowl-shaped member having in it in the path of travel of air toward the surface of the liquid in the reservoir an imperforate circular shelf which is disposed below the static level of liquid in the reservoir but above the bottom of the generally bowl-shaped member, and a baffle extending upwardly and in the direction of travel of air through the air cleaner from the edge of the shelf.

24. In an air cleaner, air inlet and outlet orifices, a generally bowl-shaped member which constitutes a liquid reservoir, a generally cylindrical member disposed within the generally bowl-shaped member and spaced from the side and lower walls thereof to define a passage through which air may travel downwardly from the air inlet orifice toward the surface of the liquid in the reservoir and a passage through which air may travel upwardly from the surface of the liquid in the reservoir toward the air outlet orifice, means in the last mentioned passage to remove from the air which travels through it foreign matter and liquid picked up by the air from the supply in the reservoir, and a circular baffle which extends upwardly in the direction of travel of air through the air cleaner from a point below to a point above the static level of liquid in the reservoir and has an imperforate portion below the static level of liquid in the reservoir.

25. In an air cleaner and silencer assembly, a shell which constitutes an element of a silencer, a head secured over one end of the shell, a duct which includes a tubular member through which air is conducted into the shell and which is secured in and opens through the head, an annular member disposed over the head with the orifice in it aligned with the tubular member and its inner edge spaced lengthwise of the assembly from the head so that it defines therewith a continuation of the duct and recess which opens into it throughout its circumference, and a filter member through which air passes into the duct through the orifice in the annular member mounted on the annular member.

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