May 7, 1935. W. W. LOWTHER 2,000,706

AIR CLEANER

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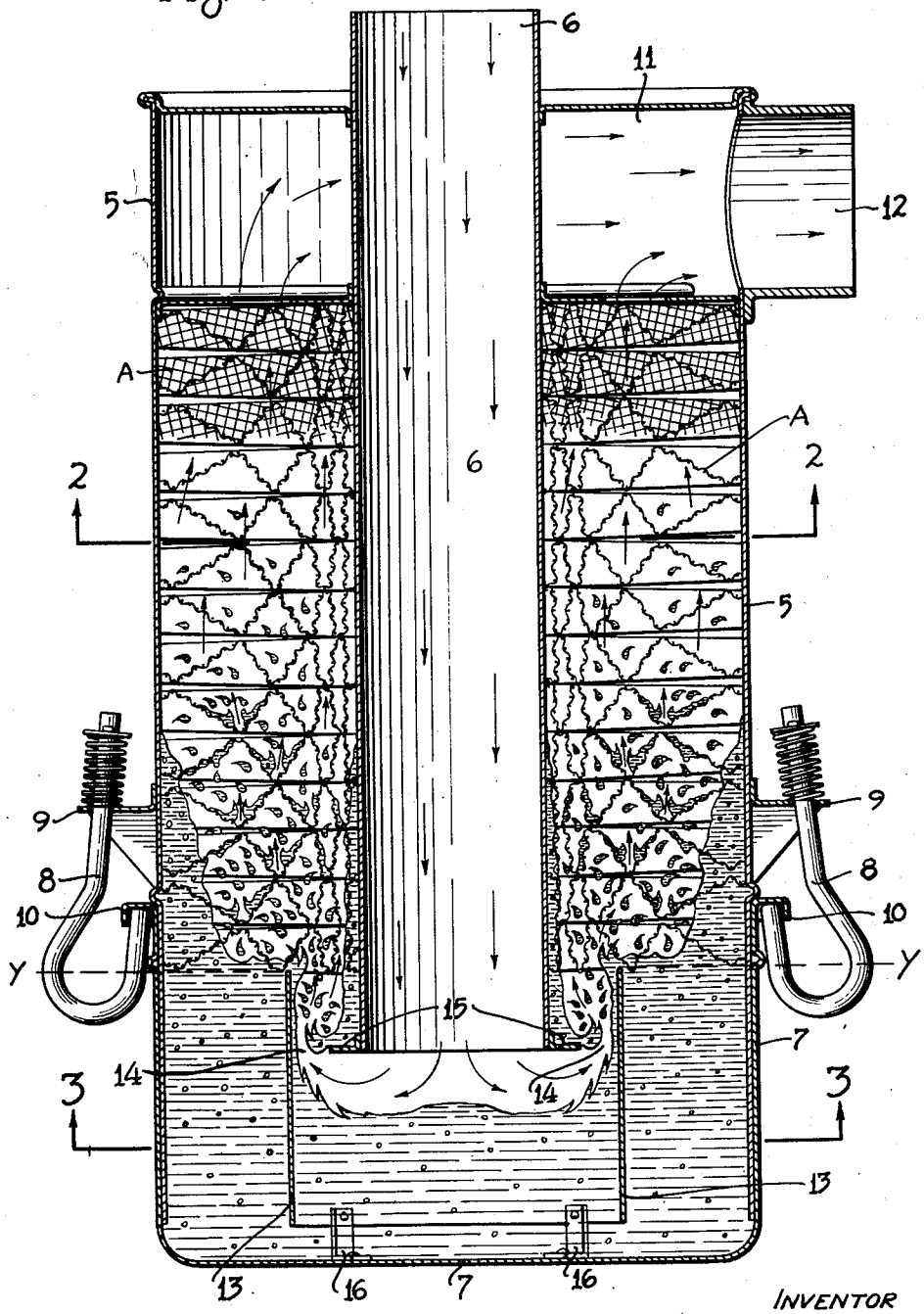
Fig. 1



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AIR CLEANER

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Fig. 2

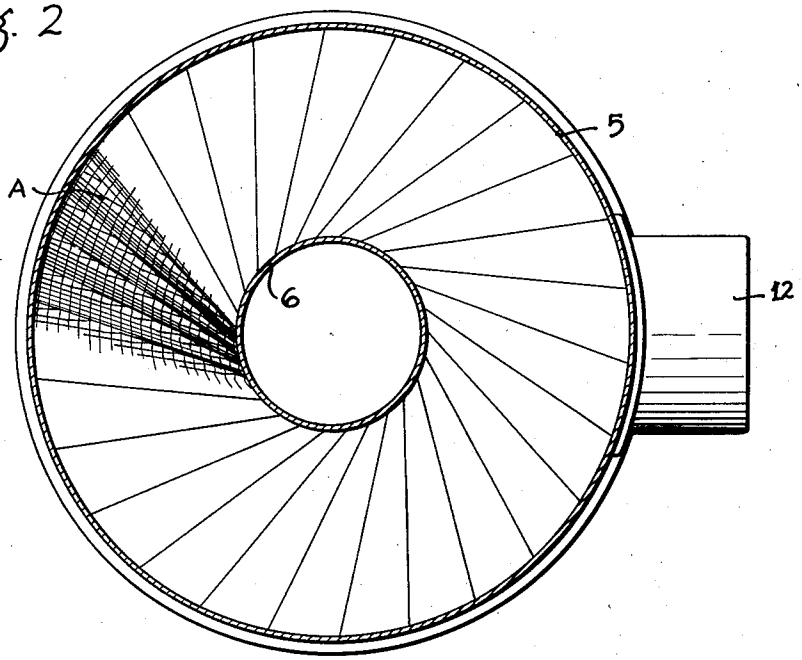

Fig. 3

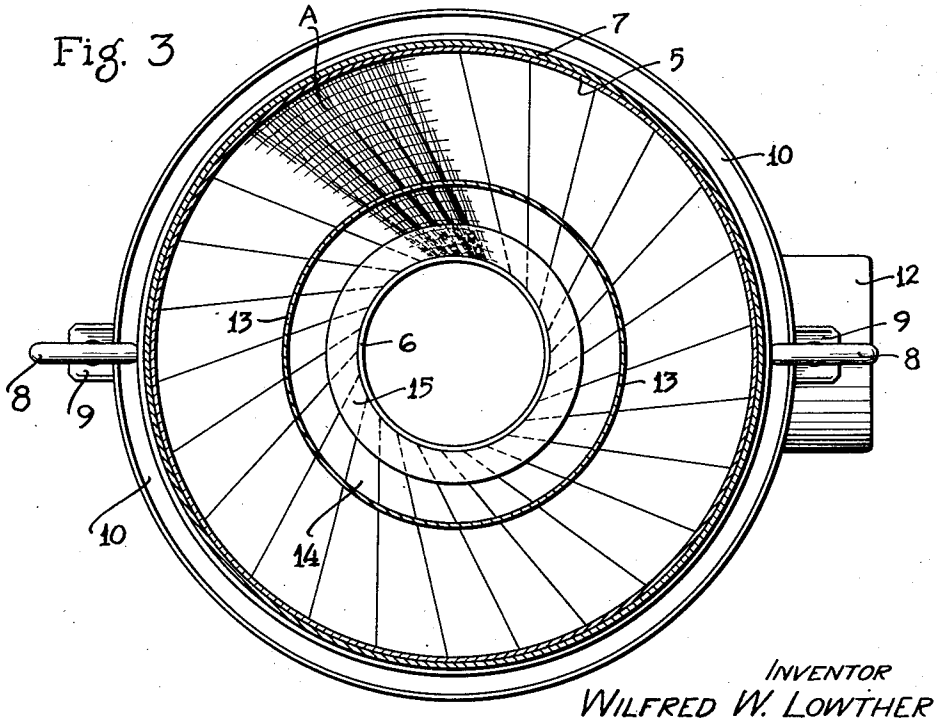

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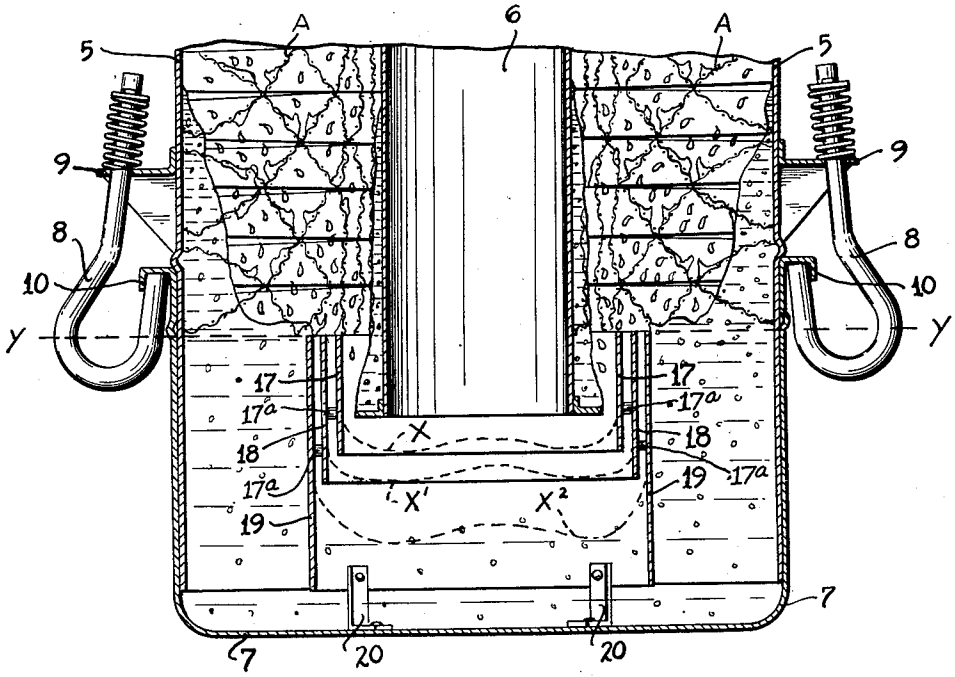
Fig. 4



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UNITED STATES PATENT OFFICE

2,000,706

AIR CLEANER

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Application December 15, 1933, Serial No. 702,482

14 Claims. (Cl. 183—15)

My present invention relates to air cleaners and has for its object to improve the same in various important particulars, whereby efficiency of the same is increased and rendered dependable and reliable, regardless of the varying flow of air through the cleaner. The air cleaner is especially adapted for use in connection with internal combustion engines. The most difficult problem in the cleaning of air delivered to internal combustion engines is encountered when air cleaners are used in connection with engines of considerable size, having a small number of cylinders, for such engines produce an uneven or pulsating flow of air, which in an air cleaner employing oil, tend to produce an uneven and inefficient dust-collecting and air cleaning action. Also, at high engine speeds, the dust-collecting and air-cleaning action tends to become less efficient.

My invention overcomes the above objections and generally increases the efficiency and reliability and dependability of air cleaners wherein oil or other liquid dust-absorbing materials are employed, all as will hereinafter more fully appear.

The invention is illustrated in the accompanying drawings, wherein like characters indicate like parts throughout the several views.

Referring to the drawings:

Fig. 1 is a vertical axial section illustrating one form of the improved air cleaner;

Fig. 2 is a horizontal section taken on the line 2—2 of Fig. 1;

Fig. 3 is a horizontal section taken on the line 3—3 of Fig. 1; and

Fig. 4 is an axial section showing the lower portion of an air cleaner of modified form in respect to one of the important elements.

Referring first to the construction illustrated in Figs. 1, 2 and 3, the air cleaner involves a casing or outer shell 5, preferably in the form of an upright cylinder, the lower end of which is primarily open. An axial air intake tube 6 extends downward through the casing 5. An oil well 7 in the form of a large cup is telescoped onto the lower end of casing 5 and, of course, normally closes the lower end of said casing. This oil well 7 is made readily detachable and is secured to the casing by suitable means, such as upwardly spring-pressed hook bolts 8 that work through lugs 9 on the exterior of the casing 5 and engage out-turned lugs 10 on the exterior of the upper edge of said oil well. At the upper end of the casing is an air chamber 11 that surrounds the upper portion of air intake tube 6 and is provided with an air outlet 12 adapted to be coupled to the carburetor of an internal combustion engine. An oil distributing dust-intercepting screen A is placed in the annular space between the casing and air intake tube and extends from the bottom of the air chamber 11 down to a point near but above the lower end of the air intake tube. This screen is preferably made from quite finely woven wire and may take various forms, for example, it may be such as that disclosed in the application of William H. Schulz Serial No. 616,860, filed June 14, 1932, and entitled "Air cleaner". For the purpose of this case, attention is simply further called to the fact that the screen, as shown, is made up of annular woven wire members, the surfaces of which are inclined in such a way that the oil intercepted will run down over and form films of oil over the openings of said screens and through which oil films the air will be caused to pass, and by which oil films the dust will be intercepted and returned to the oil well.

As a highly important feature, an annular or endless baffle 13 is placed around the lower end of the air tube 6. This baffle is spaced both from the air intake tube and from the casing and extends both above and below the lower end of said tube. An annular air passage 14 is thus formed between the lower delivery end of the air tube and the said baffle. To restrict the cross-section of this air passage at the extreme lower end of the air tube, the latter is shown as provided with an outstanding annular deflecting flange 15, the important purpose of which will more fully appear in the description of the operation. The baffle 13 may be supported or held in position by any suitable means as, for example, by small angle brackets 16 riveted thereto and to the bottom of the oil well 7. It will be noted that the upper edge of the baffle 13 extends to and practically terminates against the bottom or lowermost portion of the screen A.

Fig. 4 illustrates a modified form of the annular or endless baffle structure and wherein the same is made up of a plurality of concentrically spaced annular baffles 17, 18 and 19. In this arrangement, the several baffles are preferably terminated at about the same upper level, but at their lower edges, those that are progressively further from the air intake tube project progressively farther downward into the oil well 7. As shown, the outer baffle 19 is supported from the bottom of the oil well 7 by brackets 20, and the several baffles are tied together and spaced by any suitable means such as interposed spacing lugs.

Baffles 17, 18 and 19 are spaced apart and rigidly connected and supported by spacing lugs 17a.

Operation of structure of Figs. 1, 2 and 3

Under suction produced by the engine through the carburetor, a more or less rapid circulation of air will be drawn to the carburetor through the air intake tube, into the chamber formed within the annular baffle 13, thence upward through the screens into the air chamber 11 and out through the air discharge tube or passage 12. Air discharged from the lower end of the air tube 6 will be dashed against the oil and the oil in the said chamber will be depressed, and some thereof will be displaced into the outer portions of the oil well surrounding the annular baffle 13, thereby raising the oil level above the outer portions of the oil well and forming an annular head of oil that projects into the annular screen-containing chamber of the casing. Of course, the amount of the oil in the chamber formed by the baffle 13 is depressed and the height of the resultant annular head of oil will depend largely upon and vary with the velocity of the air passing through the cleaner. As the air makes its initial contact with and is turned upward by the oil, the surface of the oil will be dashed into a spray or form, which will be carried upward by the air into the screen chamber and through the screen openings to a greater or less height, dependent upon the force or velocity of the air, and under relatively constant engine speed, oil carried out of the chamber formed by the annular baffle 13, will be continually replaced by oil flowing in under the annular baffle 13 from the outer portions of the oil well, below the head of oil.

This continued replacement of oil from the chamber formed by the baffle 13 is obviously the result of a higher level of oil being maintained outside of the baffle than within the same, during the operation of the cleaner. Oil carried upward into the screen chamber will be caught by the screen elements and caused to run downward over the declined surfaces thereof and form films over the openings therein, through which openings air and whatever dust remains therein must pass. In this manner, all dust remaining in the air after the dust-laden air is turned upward against the surface of the oil, is intercepted by oil at some point during its travel through the screen chamber and will be returned to the well with downwardly flowing oil, since, as previously indicated, there is a continuous return flow of oil from the outer portions of the oil well into and out under baffle 13. It will be obvious that some of the oil caught by the screen elements will run down the outward declines thereof to the outer portions of the casing and even be deposited in the annular head of oil and some of the oil caught by the screen elements will run down the inward declines thereof toward intake tube 6. Oil from the head of oil maintained above and outward of the baffle 13 will tend to and, in fact, will overflow the upper edge of baffle 13 and upon entering the air stream at this point of high air velocity, will be again whipped up by the air and returned to the screen chamber in an atomized form. Since the increased suctional area of the air passage is greatly restricted immediately above the baffle 13, the air rapidly expands at this point and, of course, this expanding of the air will cause all oil suspended in the air stream above the baffle 13 to be finely broken up so as to produce the referred to atomization or breaking up of the oil.

In practice, I have found it highly desirable to produce a relatively rapid movement of the air close to the point where the air makes its initial contact with the oil, to wit: at the place where the air makes its upward turn against the oil and between the lower end of the air intake tube and the baffle 13. This passage 14 is restricted by the annular flange 15, which performs a secondary highly important function, to wit: it forms an eddy space adjacent to the lower outer surface of the air tube along which the oil is free to run downward, as indicated in Fig. 1. This oil, when it reaches the flange 15, will be deflected outward into the rapidly travelling upwardly moving air and will be again carried up with the air. The flange 15 not only aids in returning collected oil to the air stream at the point where it makes its upward turn, but due to the increased restriction of air passage afforded thereby, increases the velocity of the air and therefore further aids in breaking up all air suspended oil coming in the vicinity of the upper edge of the baffle 13.

The vertical extent of the screen chamber is such that oil will not be carried upward through all of the screen elements, even by intense pulsations produced by large two-cylinder internal combustion engines. Of course, also the altitude to which the oil will be carried will be dependent upon engine speed, regardless of number of cylinders and variation in intensity of pulsations. Obviously, during the normal operation of the cleaner, under relatively constant air velocity, the only return of oil to the oil well is outside of the annular baffle.

This chamber-forming baffle 13, it is important to note, is so completely open at its bottom that the oil, when at rest, will quickly seek its level both within and outside of said baffle. Hence, under varying intensity in the flow of air, the oil in the chamber within the baffle will be depressed variably but under no condition will the oil be entirely forced from the interior of said baffle, but on the contrary, there will be such free supply of oil that the displacement of oil will be due entirely to the pressure from the air flowing against the oil from the discharge end of the air tube 6. The baffle 13 limits the upward flow of the oil to the screens, to the annular space between the same and the lower end of the air tube and causes the return of oil to take place chiefly through the annular space outside of said baffle. The normal level of the oil, to wit: the level thereof under static conditions is indicated by the broken line marked *y—y* on Fig. 1, which level is well above the lower end of the air intake tube. It is also important to note that the baffle 13 extends up to or approximately to the normal oil level *y* and that the screens A are brought down to or approximately to said level. These relative arrangements may be varied but, in practice, it has been found that the best results have been obtained by substantially the relative arrangement just noted and illustrated in the drawings. With the said preferred arrangement, the screens are caused to commence their action as soon as the dust-laden air passes above the said baffle 13. Of course, the large amount of the heavier dust or foreign materials in the air will be precipitated against and directly taken up by the oil where it makes its turn and initial contact with the oil against the oil surface on its way up to the annular passage 14. As the air passes upward from the said passage 14 to the screens, it will, as pre-

viously noted, be subjected to a violent commingling with the oil flowing downward against the exterior of the tube 6.

Operation of structure illustrated in Fig. 4

The operation of the structure illustrated in Fig. 4 is in most respects like or substantially like that of the structure illustrated in Figs. 1, 2 and 3. This structure, however, is especially intended for use in connection with engines wherein there is a very great range in the velocity of the air and hence in the pressure thereof produced in the surface of the oil. With the arrangement of the baffles 17, 18 and 19, when the oil is depressed only to a level indicated by the dotted line x—x, the flow of oil will be entirely upward between the flange 15 and the inner baffle 17; when the oil is further depressed as indicated by dotted lines marked x^1—x^1, the flow of oil will be not only upward through the space between flange 15 and inner baffle 17, but will also be upward between the said baffles 17 and 18; and when the oil is further depressed say to the level indicated by the dotted line x^2—x^2, the flow of oil will be upward through the passage between flange 15 and baffle 17, upward between the baffles 17 and 18, and upward between the baffles 18 and 19. This arrangement of baffles provides a sort of an oil well or chamber in which the effective diameter thereof increases substantially in proportion to the increased depression of the oil. Otherwise stated, in a cleaner incorporating these baffles, the effective capacity of the cleaner with regard to air passage restriction, increases and decreases substantially in proportion to the velocity of air passed therethrough with the result that the cleaner renders substantially the same degree of efficiency over a wide range of engine speeds and consequent variations in air velocity.

The overall dimensions of either form of the cleaner herein described, when used in connection with an internal combustion engine of given horse-power, can be relatively small as compared with most other types of cleaners employing a fluid, and this is a highly important feature, since the space allotted for air cleaner equipment is often very limited and many times results in the use of under-sized equipment.

What I claim is:

1. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, a screen in the space within said casing surrounding said air intake tube, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well that is unobstructed below the intake tube and, at its bottom has free and unobstructed communication with the bottom of said well, said annular baffle being extended to a point considerably above the lower end of said air tube and said screen being extended downward substantially to the upper edge of said annular baffle.

2. The structure defined in claim 1 in which the normal or static oil level in said well is approximately at the lower portion of said screen and the upper edge of said annular baffle.

3. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, a screen in the space within said casing surrounding said air intake tube, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well which, at its bottom, has free and unobstructed communication with the bottom of said well, said air tube at its lower end having an outstanding annular flange affording a restricted annular passage between the same and said baffle.

4. The structure defined in claim 1 in which the normal or static oil level in said well is approximately at the lower portion of said screen and the upper edge of said annular baffle, said air inlet tube at its lower end having an outstanding annular flange that restricts the annular air passage between the same and the surrounding baffle and cuts off direct upward flow of air adjacent to the lower portion of said air tube.

5. The structure defined in claim 1 in which the oil well at the bottom of said casing is detachable therefrom, is telescoped onto said casing, and extends well above the normal or static oil level of said well, said annular baffle being supported by and removable with said oil well.

6. An air cleaner comprising a casing having an oil well at its bottom and an air outlet at its upper portion, an air intake tube leading axially downward through said casing with its lower end positioned to deliver air into said oil well, and an annular baffle spaced from said air tube and from the bottom and sides of said oil well and extended to a point above the lower end of said air tube and affording a chamber within said oil well which, at its bottom, has free communication with the bottom of said well, said annular baffle being made up of a plurality of concentrically spaced rings, the rings that are progressively farther from the axis of the casing being extended progressively deeper into said well.

7. An air cleaner comprising a casing having an oil well at its bottom and an air outlet at its upper portion, an air intake tube leading axially downward through said casing with its lower end positioned to deliver air into said oil well, and an annular baffle spaced from said air tube and from the bottom and sides of said oil well and extended to a point above the lower end of the air tube and affording a chamber within said oil well which, at its bottom, has free communication wth the bottom of said well, said annular baffle being made up of a plurality of concentrically spaced rings, the rings that are progressively farther from the axis of the casing being extended progressively deeper into said well, the static or normal oil level of the well being above the lower end of said air tube and said baffle-forming rings at their upper edges being located approximately at said oil level.

8. The structure defined in claim 7 in which said air tube at its lower end and below the upper edges of said ring-forming baffles is provided with an outstanding annular flange that restricts the air passage between said air tube and the innermost ring.

9. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well that is unobstructed below the intake tube and, at its

bottom, has free and unobstructed communication with the bottom of said well, said annular baffle being extended to a point above the lower end of the intake tube and being open at its top for communication with the interior of the casing above the oil well.

10. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well that is unobstructed below the intake tube and, at its bottom, has free and unobstructed communication with the bottom of said well, said oil well at the bottom of said casing being detachable therefrom, being telescoped onto said casing, and extended well above the normal or static oil level in said well, the said annular baffle being secured to and removable with said oil well.

11. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well that is unobstructed below the intake tube and, at its bottom, has free and unobstructed communication with the bottom of said well, said oil well at the bottom of said casing being detachable therefrom, and being telescoped onto said casing.

12. An air cleaner comprising a casing having an oil well in its bottom and an air outlet in its upper portion, an air intake tube leading axially downward through said casing, a screen in the space within said casing surrounding said air intake tube, and an annular baffle in said oil well spaced from the walls and bottom of said well and from the lower end of said air intake tube, said annular baffle affording a chamber within said oil well, which, at its bottom, has free and unobstructed communication with the bottom of said well.

13. An air cleaner comprising a casing provided with an oil well in its lower portion and having an air inlet and an air outlet, dust and oil-intercepting means located in said casing between said oil well and air outlet, and a substantially annular baffle located in said oil well and affording a chamber within said well, located between said air inlet and intercepting means and past the upper edge of which baffle the dust-laden air will move on its way from said air inlet to said intercepting means, said inlet, outlet, oil well, baffle and intercepting means being in concentric arrangement.

14. The structure defined in claim 13 in which said air inlet, baffle, oil well and intercepting means are in concentric arrangement.

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