April 28, 1925. 1,535,800

M. E. ANDERSON

AIR CLEANER

Filed Sept. 30, 1924

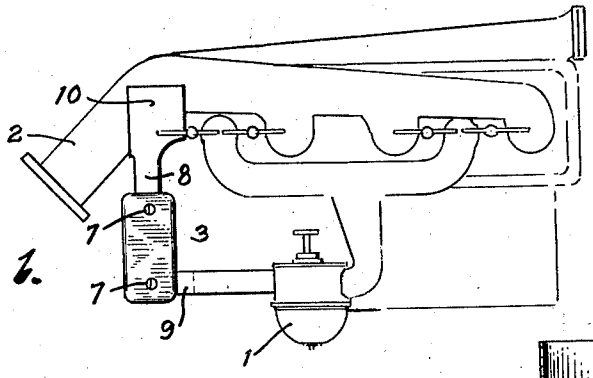

Fig. 1.

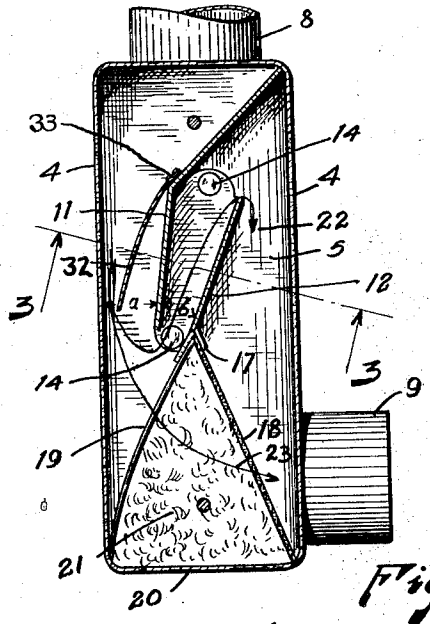

Fig. 2.

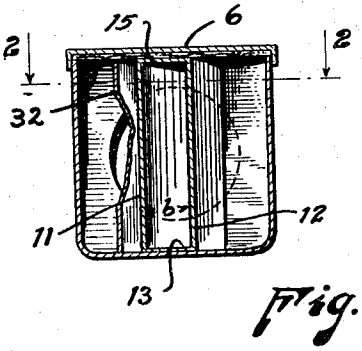

Fig. 3.

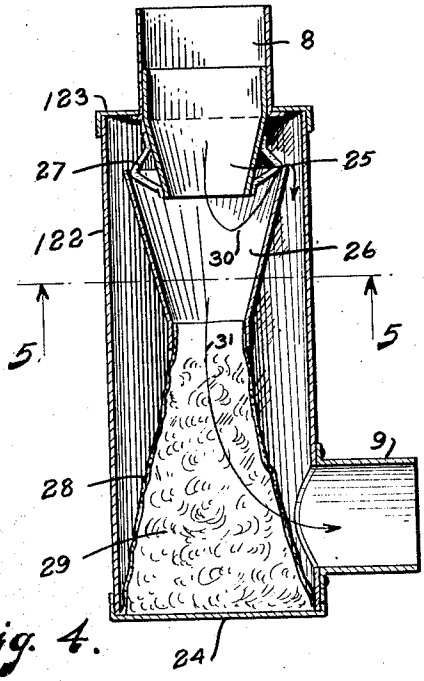

Fig. 4.

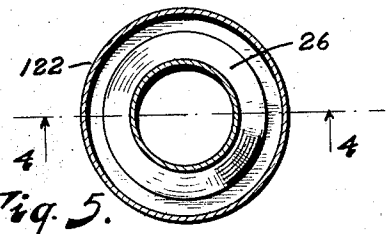

Fig. 5.

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UNITED STATES PATENT OFFICE.

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AIR CLEANER.

Application filed September 30, 1924. Serial No. 740,743.

To all whom it may concern:

Be it known that I, MARTIN E. ANDERSON, a citizen of the United States, residing at Denver, in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Air Cleaners; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the characters of reference marked thereon, which form a part of this specification.

This invention relates to air cleaners for use in connection with internal combustion engines.

It is well known that automobile engines owe their excessive wear and their comparatively short life to the fact that the air which is used in the operation of the engine is often laden with dust and sand which acts as an abradant.

In order to avoid the wear and other objectionable features due to the use of dusty air, it has been proposed to clean the air by some suitable means before it enters the engine. Where space is of no consideration, as in connection with tractors, the air may be passed thru a washer or thru a separator having a large dead air space where the dust may settle. In the latter type of devices, the air is usually forced to make a sudden sharp turn which separates the dust and dirt by a centrifugal action based on the difference in the specific gravity of the dust particles and the air. Others again pass the air thru a felt screen.

In most automobiles space is limited and this must be taken into consideration in designing an air cleaner. Then again, the grade of fuel now employed makes it necessary to heat the air before it enters the carburetor.

It is the object of this invention to produce an air cleaner of very small bulk which shall be adapted to occupy the position now usually occupied by the heater pipe which extends from the exhaust manifold to the carburetor. It is a further object of this invention to so construct my cleaner that it shall at all times permit a proper supply of air to enter the engine at all times regardless of whether the air cleaner is receiving proper attention or not.

There are two well known ways of separating dust and dirt from moving air, one depending upon the separating action produced by a sudden change in the direction and the other a filtering method in which the air is forced thru a filter medium such as felt or other fibrous material.

It is my object to produce an air cleaner in which both of the methods enumerated above are made use of to some extent each being dependent upon the other and both contributing to the result desired.

In order better and more clearly to describe my invention, I shall have reference to the accompanying drawing in which the same is illustrated and in which

Fig. 1 is a view showing in a general way the position occupied by the cleaner with respect to the carburetor and the exhaust manifold.

Fig. 2 is a section taken on line 2—2, Fig. 3.

Fig. 3 is a section taken on line 3—3, Fig. 2.

Fig. 4 is a vertical, diametrical section of a modified form of my invention, said section being taken on line 4—4, Fig. 5, and

Fig. 5 is a section taken on line 5—5, Fig. 4.

In the drawing, numeral 1 represents the carburetor and 2 the exhaust manifold of an internal combustion engine, while 3 represents the box-like portion of my improved air cleaner as a whole. My air cleaner is of exceedingly simple construction and consists, in its present preferred embodiment, of a box portion having sides 4, a bottom 5 and a removable cover 6 that is held in place thereon by means of screws 7 or other equivalent means. A pipe 8 opens into one end of the box-like member 3 and a short pipe 9 extends from one side 4 near the bottom thereof. Pipe 8 is provided at its top with an enlarged flattened portion 10 which is clamped against the exhaust manifold somewhat as shown in Fig. 1, while pipe 9 is connected to the intake opening of the carburetor. It is now evident that when my cleaner is in place and connected as described, the air which flows thru the carburetor and into the engine must also pass thru the pipe 8, box 3 and pipe 9. For the purpose of separating the sand and grit from the air, I have provided a baffle or partition wall, which I have designated by

the numeral 11, whose upper end extends into contact with the box 3 near the forward upper corner and whose lower end terminates a short distance from the front side of the rear wall 4. The space "A" is of such width that the area of the opening is substantially equal to, or slightly less than the area of the pipe 9 so that there will be no difficulty for sufficient air to pass to supply the needs of the engine. A second plate 12 is placed a short distance to the front of the lower portion of the plate 11 and spaced from the lower edge thereof a distance *b* which is preferably slightly greater or the same as the distance A. The plates 11 and 12 are preferably unitary and joined at their bases by the part 13 which is perforated for the reception of rivets 14 by means of which the plates are secured to the bottom of the box. The tops of the plates are preferably connected by a strip 15. The lower end of the plate 12 is provided with fingers 17 which may be stamped from the material thereof or secured to it in any suitable way. A screen 18 extends from the juncture of fingers 17 and plate 12 to the lower front corner of the box. This screen may be made of metal or may be a metal frame to which suitable screening fabric, such as felt, is secured, and may be readily removable for cleaning. A few wires 19 may be secured to the lower end of the plate 12 and extend to the lower rear corner of the box. These wires may be soldered at both ends as they need never be removed after they have once been put into place. Instead of wires, a rather coarse wire screen may be employed. The triangular space between the screen 18 the wires 19 and the lower end 20 may be filled with a fibrous material 21, such as a mixture of cotton and hair, wool, wool and cotton mixed, or cotton alone, the latter is not considered to be as well adapted for the purpose as the other materials as it has a tendency to pack, which is undesirable. The material 21 may be omitted, but better results will be obtained, if it is employed.

Let us now explain the operation of the cleaner that has just been described. Suppose that the engine is running air is sucked thru the pipes 8 and 9, and must pass thru the interior of the box 3. There are two ways in which the air may flow thru this box, one passage extends upwardly thru the space between the plates 11 and 12. The path of the air that flows thru this passage is indicated by the arrow 22. Another portion of the air will follow the arrow 23 and pass thru the filter material 21 and the screen 18. The air that travels the path of the arrow 22 makes a sudden, almost 180 degree turn about the lower edge of the plate 11. The dust and grit particles which have a greater specific gravity than the air are unable to make the quick turn and proceed downwardly. The air which passes thru the material 21 assists the separating effect by carrying the dust and grit along into the fibrous material 21, if this is used, or to the screen 18. I want to call particular attention at this point to the fact that I do not employ a dead air space in the sense in which this term is sometimes used in this art. The space which corresponds in position to the usual dead air space is filled with a filtering material 21 and is traversed by air currents, as above explained. These currents assist in the separation and help to carry the solid matter into the filtering medium which can be removed and replaced from time to time, or which may be removed and cleaned. I consider this a very important feature of my construction for the reason that by dispensing with a dead air chamber, I am able to effect satisfactory dust separation witn a devise so small that if it were constructed on the principle employed in dead air chamber separators, it would not produce satisfactory results. By my method, I am able to make my separator so small that it can replace the ordinary heater pipe which connects the intake of the carburetor to the space adjacent the exhaust manifold.

In Figs. 4 and 5, I have shown my invention embodied in a device having a circular transverse section. Instead of the square box, I have a cylindrical member 122 having its upper end closed by an end member 123 to which the pipe 8 is connected. The tube 9 is secured to the side near the lower end. A removable cap 24, which corresponds to the cover 6, is secured to the lower end of the cylinder 22. In order to provide a path for the air which makes it necessary for the same to make a sudden turn of substantially 180 degrees, I provide a cone 25 thru which the air enters. This cone opens into a second cone 26 which is secured and held in spaced relation to cone 26 by some suitable means such as brackets 27. Secured to the lower end of the cone 26 is a screen 28 of some sort of fibrous material. The space within the conical screen 28 is filled with a filter material 29 similar to the corresponding material 21 described in connection with Fig. 2. It is obvious that the device shown in Fig. 4 operates exactly the same as that illustrated in Fig. 2. The air enters thru the tube 8 and the greater portion thereof follows the path of arrow 30. The remainder of the air passes down into the filter material 29 and out thru the screen 28 into the tube 9 in the manner indicated by the arrow 31. When the filter material 29 has been used for some time, it should be removed and cleaned or replaced by new.

An internal combustion engine is con-

trolled as to speed and power by means of a valve which determines the amount of fuel that may pass to the same. It is evident that the control valve or throttle is fully open only at times when the maximum power output is desired, and since this occurs only at rare intervals, it is evident that the throttle valve is, as a general rule, partly closed, which means that only a small portion of the maximum amount of air flows thru the carburetor and the cleaner. The air cleaner must be so constructed that it will permit the maximum amount of air required to flow to the engine and the distance a has been determined by the maximum requirement. It is evident that the cleaning action which depends upon the inertia or momentum of the particles depends for its effectiveness to a great extent upon the velocity of the air and the solid particles at the time the turn is effected. If the opening, represented by, a, is constant for all conditions of the engine, the velocity of the air will vary with the throttle opening with the result that it will either be too low at normal operation or too high at full load. To procure the best results, it is desirable to have the area of the opening, represented by a, variable so as to obtain as high a velocity as practicable at all load and speed conditions. This is accomplished by providing a strip 32 of spring material such as phosphor bronze, and securing it at one end to the wall 11 as by means of rivets 33. As the suction of the engine increases, due to increased power delivery, the strip 32 will flex so as to increase the area of the opening thru which the air flows and by this means maintain a high air velocity under all power conditions without danger of reducing the air supply below the required amount for proper operation.

Having now described my invention, what I claim as new is:

1. An air cleaner adapted to be attached to the air intake opening of an internal combustion engine comprising, in combination, a casing having an entrance opening and an exit opening, resilient means for varying the area of the entrance opening in accordance with the volume of air passing through the cleaner, whereby the velocity of the air on entering will be high at all rates of flow means for causing the air to make a sharp turn immediately upon entering the casing whereby solid particles carried by the air will be separated therefrom and means for entangling the dust thus separated so that it will not reenter the air stream.

2. An air cleaner adapted to be attached to the air intake opening of internal combustion engine carburetor, comprising a casing having two spaced openings, said openings being connected by two passages arranged in parallel relation with each other, one of the said passages being tortuous and unobstructed and the other one having a filter medium interposed therein.

3. An air cleaner adapted to be attached to the air intake opening of internal combustion engine carburetor, comprising a casing having an entrance and an exit opening spaced from each other, resilient means for varying the area of the entrance opening in accordance with the volume of air flowing through the casing, whereby the entrance velocity of the air will be high for all rates of flow, said entrance and exit openings being connected by two passages in parallel relation with each other, one of said passages being so formed that the air that flows therethrough must make a sudden change in direction immediately upon entering, whereby solid particles carried by the air will be separated therefrom by centrifugal force and the other opening having a filter medium interposed therein.

4. A device for separating solid particles from an air current comprising a conduit having an intake and an outlet opening, means for dividing the space between the intake and the outlet into two passageways, one of which makes a sharp turn of over 90 degrees and is free from obstructions, and the other of which is provided with a filtering medium, whereby a portion of the air is caused to make a sudden turn which causes the solid matter to be separated by the combined action of the inertia and the momentum of the particles, the remainder of the air including the solid particles being caused to pass into the filtering medium.

5. A dust separator comprising a chamber having an air inlet near one end and an air outlet near the other end, a member operatively associated with the wall having the air inlet for forming a passageway for air currents, a second member spaced from the first member so as to form a passageway which communicates with the air outlet and a filtering medium extending from the second mentioned member to the inside of said chamber contacting with the latter at a point between the inlet and the outlet openings and on the side of the latter opposite from that which communicates with the second mentioned passageway.

6. In an air cleaner, the combination with a casing of an air inlet conduit in communication therewith near one end and an air outlet near the other; a deflector plate in the casing, a second deflector plate spaced from the first plate so as to form a passageway for air, and a filtering medium connecting one end of the last named plate with the interior of the casing.

7. An air cleaner comprising a casing having an air intake and an air outlet conduit connected thereto, the interior of said casing being so constructed that air may

pass from the intake to the outlet conduit thru two passageways, one of which is tortuous but unobstructed, while the other is obstructed by a filtering medium.

8. An air cleaner for internal combustion engines comprising a casing having an inlet conduit opening thereunto at one point and an air outlet conduit opening thereunto at another point, said inlet and outlet conduits being separated by a partition consisting in part of a filtering medium, said partition having an opening thru which a portion of the air may flow in passing from the intake to the outlet conduit and means for causing the air to make a sharp turn as it passes into the opening whereby a separating action takes place.

In testimony whereof I affix my signature.

MARTIN E. ANDERSON.