

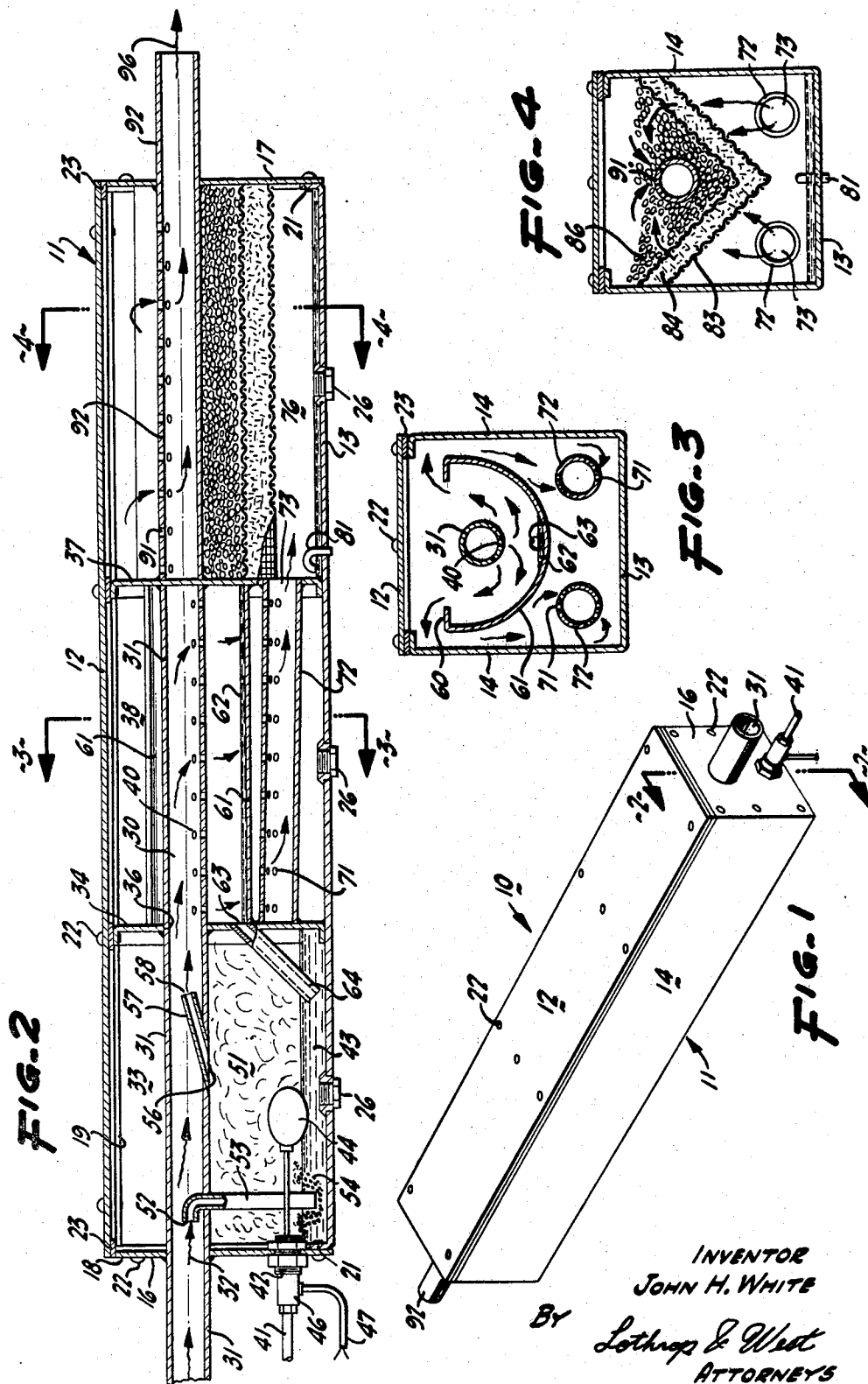
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INTERNAL COMBUSTION ENGINE EXHAUST CLEANER

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INTERNAL COMBUSTION ENGINE EXHAUST CLEANER

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10 Claims. (Cl. 60—29)

The invention relates to improvements in apparatus for removing the objectionable combustion products carried by the exhaust from an internal combustion engine.

The growing problem of air pollution has led to widespread search for equipment capable of removing undesirable gases and entrained solids, such as carbon particles and smoke from engine exhausts.

Many of the devices heretofore developed have worked in a satisfactory manner, but have frequently been bulky, expensive and difficult to maintain in proper operating condition.

It is therefore an object of the present invention to provide an exhaust cleaner which not only operates in an effective manner but which is also relatively inexpensive.

It is another object of the invention to provide a cleaner which is compact in size and which readily lends itself to installation even on small automobiles and trucks either as factory provided equipment for new vehicles or as an accessory to be attached to used vehicles.

It is a further object of the invention to provide a cleaner which is easily maintained in that the liquid used for certain stages of the cleaning operation comprises ordinary tap water and a liquid household detergent.

It is still a further object of the invention to provide an exhaust cleaner which is rugged and durable and has but a minimum of moving parts to get out of order.

It is yet a further object of the invention to provide a cleaner wherein the operator is warned of the depletion of the treated liquid used for a portion of the cleaning operation.

Another object of the invention is to provide a generally improved cleaner for the exhaust from an internal combustion engine.

Other objects, together with the foregoing, are attained in the embodiment described in the following description and illustrated in the accompanying drawings, in which:

FIGURE 1 is a front perspective view;

FIGURE 2 is a vertical, longitudinal section, to an enlarged scale, taken on the line 2—2 in FIGURE 1;

FIGURE 3 is a transverse section taken on the line 3—3 in FIGURE 2; and,

FIGURE 4 is a transverse section, the plane of the section being indicated by the line 4—4 in FIGURE 2.

While the exhaust cleaner of the invention is susceptible of numerous physical embodiments, depending upon the environment and requirements of use, substantial numbers of the herein shown and described embodiment have been made, tested and used, and have performed in an eminently satisfactory manner.

The cleaner of the invention, generally designated by the reference numeral 10, comprises a generally elongated, hollow box 11, or housing, preferably formed of a non-corrosive, sheet metal material of appropriate gauge.

The housing 11 is shown in FIGURE 1 as being substantially square in transverse section although it can assume other suitable cross-sectional configurations including circles and ellipses.

Defining the housing 11 is a top 12, a bottom 13, a pair of side walls 14, a front end plate 16 and a rear end plate 17. Conveniently, the bottom 13 and the up-

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standing side walls 14 are integrally formed by braking a sheet of metal into an angular U-shaped cross-section with inwardly turned pairs of end flanges 18 and top flanges 19, as well as an upwardly turned bottom flange 21, at each end of the box. The flanges serve, by means of suitable metal fasteners 22, to secure the end plates 16 and 17 and the top plate 12. Frequently, sealing members, such as the gasket 23 under the top plate 12, are utilized to effect a substantially air and water-tight seal. Suitable clean-out plugs 26 on the bottom 13 of the housing facilitates flushing and cleaning.

Extending from the exhaust manifold (not shown) of an internal combustion engine is an intake pipe 31, conducting the exhaust from the engine into the cleaner 10 in the direction indicated by the arrows 32.

The intake pipe 31 extends through the front plate 16 and traverses a first chamber 33, termed a forward intake chamber, defined longitudinally by the front plate 16 and by a forward transverse partition 34, the partition 34 being flanged around its periphery for securing the partition, as by welding, in an air-tight manner to the encompassing housing walls.

The intake pipe 31 continues through an opening 36 in the first partition 34 and abuts against a second transverse partition 37 after traversing an intermediate chamber 38 defined at its ends by the two partitions 34 and 37.

The portion of the intake pipe 31 located within the intermediate chamber 38 is perforated by a plurality of openings 40, the openings 40 being located adjacent the bottom portion of the pipe 31, as appears most clearly in FIGURE 3, for a purpose later to be described.

The forward intake chamber 33 serves, in the main, as a foam, or froth, generating chamber. Extending from a reservoir (not shown) located at a convenient position for refilling is a liquid conducting line 41 connected to a suitable fitting 42 mounted on the front plate 16. From the fitting 42 the liquid from the reservoir passes into the foam generating chamber 33 and forms a pool 43, or body, of water at the bottom thereof. A conventional float valve 44 controls the inflow to maintain the pool at a substantially constant level.

In many cases it is desirable that the operator be warned of a low water level, indicating that the liquid supply is approaching exhaustion. In these situations another fitting, available on the market and designated by the reference numeral 46, is provided. The fitting 46 includes a pair of internal electrical contacts which are closed as the float 44 drops to a predetermined low level, the float being connected by internal levers to the contacts. A pair of electrical conductors 47 extends from the contacts to a location, such as a dashboard, convenient to the operator's station. By suitable connection to an energy source (not shown) the conductors 47 can energize a warning lamp or, if desired, can also turn off the ignition switch and thus stop the engine when the liquid level has dropped to a predetermined elevation.

The liquid in the pool 43 can be of any one of numerous compositions. However, for convenience and economy, as well as providing a highly efficient cleansing or scrubbing foam, a mixture of tap water and liquid household detergent has been found to be eminently suitable. A solution of one teaspoon of liquid household detergent to a gallon of tap water has been found to be most satisfactory.

Churning of the treated liquid pool 43, so as to produce a large mass of foam 51 within the chamber 33, is effected by leading a portion of the exhaust, passing through the intake pipe 31, into the forwardly facing opening 52 of a pipe 53 extending downwardly through the wall of the intake pipe 31 and depending into the liquid pool 43. The exhaust gases so diverted, effect a forceful bubbling action in the water, as at 54, and thus churn the

dilute detergent solution so as to create and maintain the mass of froth or foam 51 filling the chamber.

The foam so produced is thereupon injected into the exhaust stream 32 through an opening 56 in the bottom of the intake pipe 31.

By constricting the cross-section of the intake pipe 31, as, for example, by inserting an injection pipe 57 in the manner and location shown, and with the outlet 58 of the injection pipe facing downstream, a lowered pressure, or Venturi effect, is achieved, thus assisting in the continuous introduction of a substantial quantity of foam into the exhaust flow.

As will be realized, that portion of the exhaust withdrawn through the bubble pipe 53 and bubbled into the pool 43 will have, by this time, been thoroughly cleaned. Furthermore, the mass of foam 51 will, in the main, be relatively free of many of the objectionable materials in the exhaust, these materials having been captured by the liquid pool.

Thus, as the moderately clean foam emerges from the injection pipe opening 58, it quickly and thoroughly intermingles with the exhaust flowing toward and into the perforated portion 30 of the pipe 31, that is to say, the portion of the pipe 31 within the intermediate chamber 38.

In traversing the perforated portion 30 of the pipe 31, the intermingled exhaust and foam change direction rapidly and flow downwardly through the openings 40, and thereupon impinge against the adjacent walls of a catch basin 61.

The catch basin is generally U-shaped in transverse section and extends longitudinally between the two transverse partitions 34 and 37. The upper margins of the catch basin are preferably bent inwardly for installations on moving vehicles to form splash lips 60 helping to confine within the basin a small catchment 62 of condensate, the condensate being continuously drained from the catchment through an opening 63 in the partition 34, thence forwardly and downwardly through a condensate return pipe 64 to a location below the liquid level in the pool 43.

In other words, as a result of the somewhat cooler environment in the middle chamber, the sudden changes in direction of the intermingled foam and exhaust, the drawing-in effect on the foam bubbles as they pass through the relatively small apertures 40 in the pipe 31, and their impingement against the walls of the catch basin 61 upon emerging from the apertures 40, a considerable amount of foam is reconverted to the liquid state. The exhaust materials previously entrained in the foam are thenceforth trapped in the reconverted liquid and are returned through the condensate return pipe 64 to the pool 43.

Such small and light froth and attendant residual exhaust materials as still remain are swept over the lips 60 and downwardly over the outer surfaces of the catch basin (see FIGURE 3) to enter through a plurality of small openings 71 in a pair of conduits 72 abutting the forward partition 34 at their front ends and extending to the after partition 37 where they discharge through ports 73 into an after outlet chamber 76 defined longitudinally by the after partition 37 and the rear plate 17.

It is to be noted that the small openings 71 in the two conduits 72 are arranged in rows located in mirror symmetry (see FIGURE 3). In other words, the upper rows of openings 71 on the conduits are disposed inwardly somewhat toward each other, whereas the lower rows are removed somewhat outwardly or away from each other, this arrangement being such as to cause the light froth and entrained exhaust to undergo still further sudden changes of direction as they continue along their path, and thus reconvert the foam to liquid state. By inclining the conduits slightly downwardly toward the discharge ports 73, such condensate as is formed in the conduits flows into the after chambers 76. A low-profile syphon 81 in the floor of the after chamber 76 periodically drains any collected condensate and discharges it to waste.

Upon entering the after chamber through the ports 73, any froth, entrained soluble gases and such uncaptured solid particles as remain are directed upwardly through a V-shaped filter 83 of metallic wool 84, thence through a porous bed 86 of granulated rock.

Since exhaust gases ordinarily contain substances tending toward the acidic, such as compounds of sulfur and nitrogen, it has been found that limestone particles having an effective diameter of approximately ¼ inch to ½ inch are very effective as neutralizers, these crushed limestone aggregates having the further advantage that they are readily available, as at plant nurseries, and are cheap in price.

After traversing the metallic wool filter and the bed of porous rock particles, the residual components flow through openings 91 in an exhaust pipe 92 abutting at its forward end the after partition 37, extending across the after chamber 76 and passing through the rear plate 17 to discharge into the atmosphere, as indicated by the arrow 96.

It can therefore be seen that I have provided a device which, by a combination of mechanical and chemical operations, effectively cleans the exhaust gases from an internal combustion engine.

What is claimed is:

1. An internal combustion engine exhaust cleaner comprising:

(a) an elongated housing closed at its ends by a front plate and a rear plate;

(b) a pair of spaced, interior, transverse partitions within said housing dividing the interior of said housing into a forward intake chamber, an intermediate chamber and an after outlet chamber;

(c) an intake pipe connecting to the exhaust manifold of an internal combustion engine, said pipe extending through said front plate, through said forward intake chamber, through the forward one of said pair of transverse partitions, through said intermediate chamber and terminating at the after one of said pair of transverse partitions, said intake pipe including a plurality of apertures opening into said intermediate chamber;

(d) a liquid conducting line leading from a reservoir of treated liquid and discharging into said forward intake chamber;

(e) means for converting to foam a portion of the treated liquid within said forward intake chamber;

(f) means for injecting the foam in said forward intake chamber into said intake pipe into the path of the engine exhaust passing through said intake pipe, said foam and said exhaust becoming intermingled and discharging through said apertures into said intermediate chamber;

(g) a catch basin within said intermediate chamber below said intake pipe to hold a portion of the foam reconverted to liquid state and containing a first fraction of exhaust materials entrained therein;

(h) a perforated conduit in said intermediate chamber and extending to a port in said after partition to discharge into said after outlet chamber, said conduit being effective to carry to said after outlet chamber a residual portion of exhaust materials;

(i) an exhaust pipe extending from said after partition through said after outlet chamber and through said rear plate to discharge into the atmosphere, said exhaust pipe including an apertured portion within said after outlet chamber; and

(j) filter means interposed in said after outlet chamber between said discharge part of said perforated conduit and said apertured portion of said exhaust pipe, said filter means being effective to remove a remaining portion of exhaust materials, the relatively clean gaseous product entering said apertured portion of said exhaust pipe being discharged by said exhaust pipe into the atmosphere.

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2. A device as in claim 1 including valve means connected to said liquid conducting line for controlling the quantity of treated liquid introduced into said forward intake chamber.

3. A device as in claim 2 wherein said valve means comprises a float valve.

4. A device as in claim 2 including a condensate return pipe extending from the bottom of said catch basin through said forward partition and into said forward intake chamber.

5. A device as in claim 4 wherein said means for converting to foam a portion of the treated liquid within said forward intake chamber includes a foam pipe having one end extending into said intake pipe and facing the oncoming exhaust, the other end depending into the body of treated liquid within said forward intake chamber, a portion of the oncoming exhaust being thereby deflected into said liquid body to effect foaming thereof.

6. A device as in claim 5 wherein said means for injecting foam in said forward intake chamber into said intake pipe comprises a tube on said intake downstream from said foam pipe, said tube being in communication with the body of foam within said forward intake chamber and opening into the interior of said intake pipe, the

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cross-sectional area of said intake pipe being reduced adjacent thereto to create a Venturi effect.

7. A device as in claim 6 wherein said catch basin is substantially U-shaped in transverse section and wherein the upper margins of said catch basin are turned inwardly to form splash plates.

8. A device as in claim 7 including syphon means mounted on the bottom of at least said after outlet chamber for draining liquid accumulating on the bottom thereof.

9. A device as in claim 8 wherein said filter means includes a pad of metal wool partially encompassing the bottom portion of said exhaust pipe within said after outlet chamber, and a body of permeable rock particles surrounding said apertured portion of said exhaust pipe.

10. A device as in claim 9 including electrical means associated with said valve means for indicating when the liquid supply in said forward intake chamber is exhausted.

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