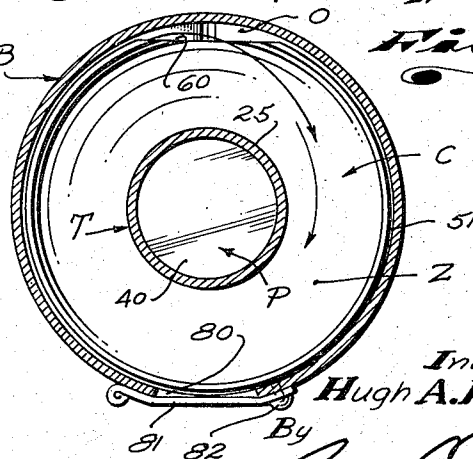
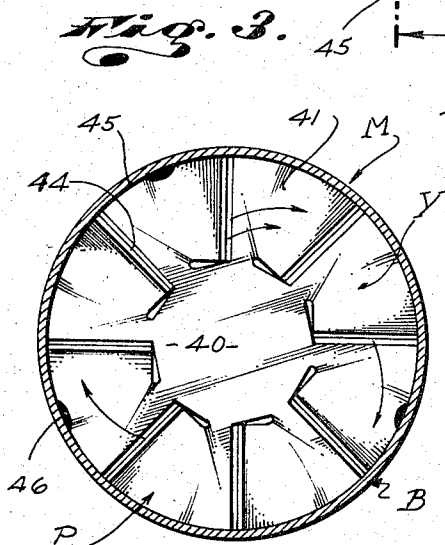
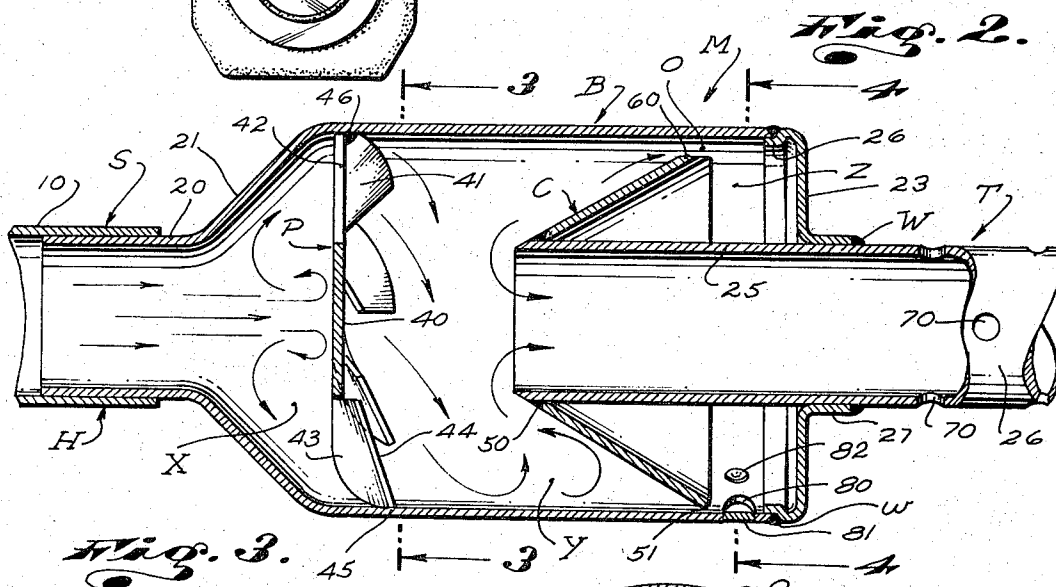
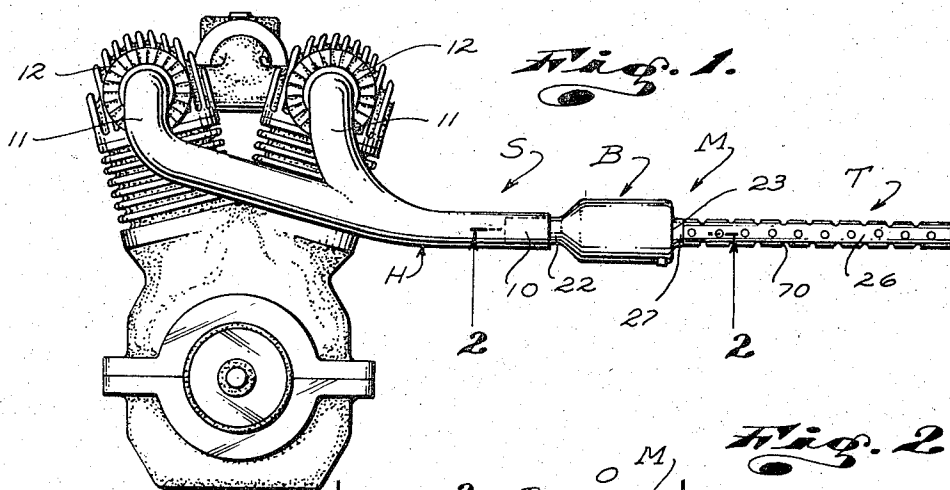


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H. A. HUTCHINS
MUFFLER CONSTRUCTION
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MUFFLER CONSTRUCTION
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An object of this invention is to provide an improved muffler construction for use in connection with internal combustion engines and is more particularly concerned with a muffler for use in connection with high-performance motorcycle engines.

The art and sport of motorcycling, while extremely old, has experienced increased activity in recent years with the development of new and specialized sporting and competitive events such as cross-country riding and racing in which motorcycles are operated in open country through grass and brush; hill climbing, in which motorcyclists race their machines up hillsides and the like.

For each of these many new motorcycling sporting and competition activities, specially designed and equipped motorcycles are employed. In an overwhelming majority of such specially designed motorcycles, the engines are high-performance engines wherein it is sought to obtain the maximum amount of power for the weight and cubic displacement of the engines.

In such high-performance engines, it is important that the exhaust systems provided to conduct the exhaust gases away from the engine allow for the free flow of such exhaust gases and create a minimum of back pressure.

As a result of this requirement, it is considered ideal or most desirable to provide a simple, straight through exhaust pipe on such high-performance engines. In practice, however, there are very few places where straight through pipes are permitted, since they do not muffle the sound of the engines and therefore create a nuisance and they do not stop or impede the flow and discharge of sparks from the engine and exhaust system, that is, the discharge of burning and glowing bits and pieces of carbon which break free from carbon deposits in the engines and exhaust systems and which create serious fire hazards.

In high-performance internal combustion engines, such as are used in connection with motorcycles and with which my muffler construction is intended to be used, the engines are frequently provided with racing cams for the valves of the engine which are such that the exhaust valves are still open when the inlet valves open and the pistons start their intake stroke.

As a result of this "overlap" in the valving of such engines, it is not infrequent that gases flowing through straight through exhaust pipe systems will, when the throttle valves are closed or restricted to slow the engine, draw and scavenge a critical portion of the fuel air mixtures from the cylinders of the engines, with the result that the engines will stall, fade or die; particularly when the throttle valves are again and rapidly returned to their full open positions, as is frequently the case in competition events.

Still further, in such high-performance engines, and where straight through exhaust pipes are provided, the above-noted scavenging effects of the gases flowing through the pipes make it impossible or very difficult to operate such engines at low speeds.

As a result of the above, it will be apparent that straight through pipes, in spite of their obvious and apparent advantages, create other problems which render them unsuitable or wanting.

While the prior art has provided many forms of mufflers for inclusion in the exhaust systems for motorcycles, with the view of muffling sound; such mufflers characteristically create back pressures which, while not excessive for low-performance engines, are much too great for high-

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performance engines and result in considerable loss of power and limit the maximum potential speed and operation of the engines.

Further, the ordinary muffler construction not only fails to effectively and efficiently arrest the issuance of sparks from the system to which it is related, but, in fact, tends to induce build up of carbon deposits within its structure which ultimately cause or result in the production of sparks to issue from the system. That is, ordinary mufflers are not effective as spark arresters, but may be better characterized as spark generators.

As a result of the above, in those situations where the emission of sparks is prohibited, spark arresters must be added to the exhaust systems. Such spark arresters have been characterized by canisters engageable in the exhaust systems, which canisters are filled with screening means which will stop and trap the sparks or embers and prevent their emission from the system to which they are related. In such devices, the greater the efficiency to stop sparks, the greater the back pressures which are generated. Accordingly, since the maximum amount of back pressures which can be tolerated is rather low, the efficiency of such spark arresting devices is also and necessarily rather low.

Further, the ordinary spark arrester in addition to being a separate device applicable to an exhaust system as an accessory, is such that it must be regularly replaced or serviced.

An object of my invention is to provide a novel and improved muffler construction for arrangement in the exhaust system of an internal combustion engine which is highly effective and dependable in silencing the exhaust of the engine; is extremely efficient and effective to arrest sparks and which allows for the free flow of exhaust gases from the engine with less back pressures than is generated in exhaust systems by ordinary or conventional mufflers and/or spark arrester constructions.

Another object of this invention is to provide a muffler construction of the character referred to which is such that it allows for the free flow of exhaust gases, with a minimum amount of back pressure and yet effectively prevents the gases moving through the system from scavenging the fuel air mixture from the cylinders of the engine, in those high-performance engines, where the exhaust ports are open at the start of the intake stroke of the pistons in the cylinders.

Another object of this invention is to provide a structure of the character referred to which is considerably smaller, neater and more compact than ordinary muffler constructions, a structure which is rugged, durable and longlasting, a structure which requires no service or maintenance and a structure which is easy and economical to manufacture and install.

The foregoing and other objects and features of my invention will be fully understood from the following detailed description of a typical preferred form and application of my invention, throughout which description reference is made to the accompanying drawings, in which:

FIG. 1 is an elevational view of an engine with an exhaust system having the muffler construction that I provide related thereto;

FIG. 2 is an enlarged, detailed sectional view taken substantially as indicated by line 2—2 on FIG. 1;

FIG. 3 is a transverse sectional view taken as indicated by line 3—3 on FIG. 2; and,

FIG. 4 is a transverse sectional view taken as indicated by line 4—4 on FIG. 2.

In FIG. 1 of the drawings, I have shown an exhaust system S related to an internal combustion engine E, which systems includes a header H having an elongate rearwardly extending rearwardly opening rear end por-

tion 10 and a pair of forward branch portions 11 connected with the engine, as at 12 to communicate with the exhaust ports thereof (not shown) and a muffler construction M as provided by the present invention connected with and extending rearwardly from the rear end portion of the header.

Since the engine E can be of any form of internal combustion engine and it can vary widely in form and design without affecting the novelty of this invention, I will not burden this application with further detailed description of the engine illustrated.

Also, since the header H, in accordance with common practice, is especially designed for the engine, further detailed consideration and description thereof can be dispensed with. It is sufficient to state that the header H is established of tube stock, is connected with the exhaust ports of the engine and has a rearwardly projecting, rearwardly opening rear portion 10 to connect with the remainder of the exhaust system, that is, the muffler M.

The muffler M includes an elongate cannister-like body B with a cylindrical side wall 20, larger in diameter than the rear portion 10 of the header H, forwardly and radially inwardly inclined front wall 21 with a central forwardly projecting tubular neck 22 to slidably engage and connect with the rear end portion 10 of the header H, a substantially radially extending axially disposed rear wall 23, with a central opening 24, a radially extending axially disposed plate member P arranged in and spanning the interior part of the body at the forward portion thereof, an elongate tail pipe or discharge tube T having open front and rear ends engaged through the opening 24 in the rear wall 23 to be supported thereby and having a forward portion 25 projecting freely into the body to terminate in the central portion thereof and a rear portion 26 projecting rearwardly from the body and a radially outwardly and rearwardly inclined directing cone C carried by the front or forward portion 25 of the tail pipe T and occurring within the rear portion of the body.

The neck 22, front wall 21 and side wall 20 of the body B, can, as shown, be formed integrally by suitable drawing and/or spinning operations.

The rear wall 23 is a separate part established by suitable drawing and/or spinning operations and is shown as having a forwardly projecting annular flange 26 defining a forwardly disposed stop shoulder about its outer periphery and a central rearwardly projecting tubular neck or sleeve 27 defining the opening 24 and adapted to provide bearing support for the tail pipe T.

The tail pipe T is slidably engaged through the opening 24 or sleeve portion 22 of the rear wall and is secured in fixed position therein by welding W.

The flange 26 on the rear wall slidably enters the rear end of the side wall to stop against the rear edge thereof and is welded thereto as by W.

The neck 22 at the forward end of the body is adapted to slidably engage about the rear end portion of the rear portion 10 of the header H, or, as shown, to slidably enter the open rear end of the header, to seal therewith.

The plate member P is established of flat or sheet stock and is arranged and fixed in the body in spaced relationship from the front wall 22 thereof to define a forwardly convergent front receiver chamber X.

The member P is provided in its central portion with a flat, radially extending, substantially disc-shaped portion defining a baffle 40 having a forwardly disposed flat surface and arranged in axial alignment with the neck 22 and in spaced relationship from the neck and the front wall of the body.

The baffle 40 is spaced from the neck and front wall of the body a predetermined distance so that the impinging stream or flow of exhaust gases and the attending sound waves flowing into the chamber X, from the header H and through the neck, impinge upon the baffle and are bounced back, forwardly towards the neck and

into the central portion of the forwardly convergent receiver chamber X, defined by the front wall 22 and the member P.

The baffle 40 is slightly larger in diameter than the inside diameter of the neck so that direct rearward flow of gases into the body and by the member P is prevented.

As best as can be determined, the baffle 40, in operation, buffers the impulses in the stream of gases and/or creates standing waves back up in the neck and the header which, while not interfering with the free flow of gases rearwardly and out of the header, prevent the gases from developing a flow which would tend to draw and create the scavenging effect referred to in the preceding.

In addition to the foregoing, the member P includes a plurality of circumferentially spaced, radially outwardly projecting vanes 41 formed integrally with the baffle 40 and bridging between the baffles and the side wall 20 of the body B. The vanes 41 are pitched circumferentially and rearwardly to direct gases flowing thereby and therebetween circularly in the body, rearward of the member P.

The vanes 41 have radially extending leading edges 42 which occur in the same plane as the baffle, circumferentially and rearwardly inclined flow directing front surfaces 43, rearwardly and outwardly inclined trailing edges 44 and outer peripheral edges 45 which extend substantially helically rearward and bear on the inner surface of the side wall 20.

The member P is fixed in position in the body B by welds 46 between the side wall of the body and certain of the vanes.

The adjacent vanes 41 cooperate to establish circumferentially spaced openings communicating with the outer peripheral portion of the forward chamber X. The accumulative cross-sectional area of the openings established by the vanes in many times greater than the cross-sectional area of the neck 22, whereby the flow of gases through the construction, while directed helically as it passes or moves through the member P and by the vanes, is not restricted thereby so as to create undesired or substantial back pressures.

The directing cone C on carried by the forward end of the front portion 25 of the tail pipe T, within the central and rear portions of the body B, is a simple truncated conical sheet metal part formed as by drawing and/or spinning. The forward edge of the truncated cone shaped part C is slidably engaged about and is welded to the front end of the pipe T, as at 50. The outer rear edge 51 of the cone is spaced forward of the rear wall of the body and is in spaced relationship from the inside surface of the side wall 20 of the body a distance sufficient to permit the movement or passage of particles of, twenty-thousandths of an inch or less therethrough.

In practice, and instead of providing uniform clearance between the rear edge 51 of the cone and the inner surface of the side wall of the body, the said rear edge 51 can be in working bearing engagement with said surface of the side wall and is sufficiently irregular so that such particles are free to move and migrate between said edge and said side wall.

The cone C cooperates with the side wall and the member P to define a central separation chamber Y and cooperates with said side wall forward portion of the tail pipe and the rear wall to define an annular rear trap chamber Z within the body B.

The cone C is relieved about a portion of its outer rear edge 51 to establish a passage or opening O at the outer peripheral portion of the cone adjacent the side wall 20 of the body and establishing communication between the chambers Y and Z.

In the case illustrated, the opening O is established by cutting and removing a portion of the cone along a core line, as at 60. In practice, the opening O could be established in any suitable manner, as for example, it

could be established by simply bending a portion of the outer rear edge portion of the cone radially inwardly to a desired and necessary extent.

The rear portion of the tail pipe T is provided with a plurality of circumferentially and axially spaced openings or apertures 70 which serve to relieve the gases flowing therethrough to prevent the establishment of undesirable pressures and to prevent the generation of undesirable harmonics which would otherwise be established and/or generated in the tail pipe by the gases flowing therethrough. The apertures 70 are of such size and are spaced longitudinally of the pipe in such a manner that each is capable of conducting a small fraction of the exhaust gases flowing through the pipe out of the pipe and act collectively so that the volume, velocity and pressure of the gases flowing through the rear portion of the tail pipe are progressively diminished in such a manner that at no time and at no place, throughout the longitudinal extent of the pipe, is there gases escaping at such pressures, velocity and in such volume as would create undesirable noise or wound or create undesirable and/or dangerous blasts of gases.

In addition to the foregoing, I provide an access opening 80 in the lower portion of the side wall 20 of the body, communicating with the chamber Z. The opening 80 is normally closed by a suitable closure 81 which, in the case illustrated, is a simple, elongate leaf spring-type closure plate having one end pivotally secured to the body adjacent one side of the opening, as at 82. The other end of the spring or plate 81 is adapted to be manually engaged and sprung away from the body to facilitate pivoting the spring or plate into and out of engagement over said opening, as circumstances require.

The opening 80 is provided to effect the discharge of foreign matter, such as bits of carbon collected in the chamber Z during operation of the construction, if such cleaning becomes necessary.

In operation, the gases flowing through the header H are conducted axially into the center of the front or forward chamber X in the body, by the neck 22 and impinge upon the baffle 40 to be deflected radially and rearwardly into the outer peripheral portion of the chamber X. The forwardly and radially inwardly inclined front wall 21 serves to re-direct the gases radially outwardly and rearwardly in the chamber into engagement with the vanes 41 and through the openings defined by said vanes and into the chamber Y. The vanes 41 direct the rearwardly moving gases circumferentially and rearwardly in the chamber Y to establish a circular or cyclonic movement of said gases in the chamber Y. The cyclonic movement of the gases causes the heavy gases and any and all heavy particles, such as bits and pieces of carbon, condensed moisture and/or unburned fuel carried by the gases to be passed by centrifugal force, radially outwardly in the chamber Y and about the inner surface of the side wall 20 of the body, as the gases move rearwardly therein. The inertia of the heavier gases and/or particles causes them to move rearwardly in the chamber X about the cone C. The outer radially outwardly and rearwardly inclined surface of the cone C and the adjacent inner surface of that portion of the side wall 20 of the body occurring about the cone C cooperate to direct all heavy matter flowing rearwardly in and about the chamber Y into the outer rear corner of the chamber established by the side wall and cone and thence into and through the opening O and into the chamber Z.

The lighter gases entering the chamber Y are displaced radially inwardly and forwardly in the chamber Y by the heavier matter which is cast radially outwardly in the chamber by centrifugal force and which moves rearwardly therein. The lighter gases, being thus displaced radially inwardly in the chamber, are free to enter the open forward end of the inner portion 25 of the tail pipe T communicating with the chamber Y, at the forward end of

the cone, and to flow rearwardly and outwardly through the tail pipe.

While the chamber Z is substantially isolated from the chamber Y, the circular or cyclonic movement of the matter flowing from the chamber Y through the opening O and into the chamber Z induces a continual, though reduced, cyclonic movement of gases in the chamber Z, which effectively and continuously tumbles and mills the solid particles of carbon and the like deposited in the chamber Z, with the result that the particles, if larger than twenty-five thousandths of an inch, are reduced to such a size or smaller. When the solid particles are so reduced, it will be apparent that they are free to move and migrate forwardly and back into the chamber Y between the outer edge 51 of the cone and the adjacent side wall 20 of the body, as mentioned in the preceding.

It will be apparent that the materials or matter thus moving back into the chamber Y might and frequently are engaged and picked up by the rearwardly moving gases and matter in the chamber Y and are or can be redeposited into the chamber Z. Such recycling of the matter may take place several times. Each time this action occurs, the matter is again acted upon, milled and reduced. Eventually, such matter is so reduced that when it moves from the chamber Z back into the chamber Y in the manner set forth above, it is displaced radially inwardly and forwardly in the chamber Y, by the heavier gases and matter and is discharged through the tail pipe T with the lighter gases.

Should the chamber Z be loaded or charged with an excessive amount of solid matter, that is, should so much solid matter be deposited therein that the above action cannot take place or proceed, the excessive matter deposited in the chamber Z can be removed therefrom through the opening 80 by simply manually moving the closure plate 81 from engagement over said opening.

The gases entering the forward open end of the tail pipe T and flowing rearwardly therethrough continue to flow rearwardly into and through the rear portion of the tail pipe T and are progressively exhausted from said tail pipe through the apertures 70 therein, in the manner set forth above.

Further, in operation, the continuing supply and cyclonic flow of heavy matter into the chamber Y serves to accelerate the cyclonic flow of the lighter gases displaced radially inwardly and forwardly thereby. Certain of the inwardly and forwardly accelerated gases impinge upon the rear surface of the baffle and are directed axially rearwardly into the forward open end of the tail pipe and thence rearwardly therethrough.

It is believed that the above noted acceleration of the lighter gases by the heavier gases and matter creates a minus pressure in the central forward portion of the chamber Y which tends to draw and induce the flow of gases from the chamber X into the chamber Y, thereby scavenging the chamber X of gases and reducing the amount of back pressure generated in the chamber X and the header H related thereto.

The velocity of the cyclonic movement of the column of gases traveling rearwardly through the forward portion of the tail pipe is substantially maintained as said gases are not permitted to expand radially. When the gases reach the rear perforated portion of the tail pipe and are bled off through the perforations 70, the cyclonic movement of the gases in the tail pipe progressively slow and dissipate. The said gases flowing through the tail pipe do not, as a whole, impinge upon a mechanical surface or a body of air in such a manner as would create a buffering effect and establish or induce the establishment of excessive back pressures in the forward portion of the tail pipe and in the body of the muffler.

It is believed that the above action contributes to the great deficiency and effectiveness of my construction.

Having described only a typical preferred form and application of my invention, I do not wish to be limited or

restricted to the specific details herein set forth, but wish to reserve to myself any modifications or variations that may appear to those skilled in the art and which fall within the scope of the following claims.

Having described my invention I claim:

1. A muffler construction of the character referred to including, an elongate, normally horizontally extending, tubular body with a cylindrical side wall and front and rear end walls, an elongate, central, forwardly opening, tubular inlet neck on and projecting forwardly from the front wall and communicating with the interior of the body, an elongate forwardly and rearwardly opening tail pipe concentric with and carried by the rear wall and having a forward portion projecting freely into the body and a rear portion projecting freely rearwardly from the body, a flat radially extending disc-shaped baffle in the central forward portion of the body and spaced rearwardly from the front wall and radially inward from the side wall and cooperating with said front and side walls to define a forward receiver chamber, a plurality of circumferentially spaced, radially extending vanes between the baffle and the side wall and pitched to impart cyclonic motion in and to gases and matter flowing rearwardly in the body between the baffle and the side wall, and a radially inwardly and axially forwardly inclined directing cone in the body between the forward end of the tail pipe and the side wall and spaced axially between the baffle and the rear wall to cooperate with the said baffle, side and rear walls to define a central separator chamber and a rear trap chamber, the outer rear portion of the cone being formed to define an axial opening adjacent the top of the side wall establishing communication between the separator and trap chambers.

2. A structure as set forth in claim 1 wherein the rear portion of the tail pipe is provided with a plurality of circumferentially and longitudinally spaced, radially outwardly opening apertures.

3. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber.

4. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber, said front wall being radially outwardly and axially rearwardly inclined and adapted to redirect the radially outwardly moving gases axially rearwardly.

5. A structure as set forth in claim 1 wherein the cone is fixed to and carried by the tail pipe and is related to the side wall whereby clearances occur between the outer periphery of the cone and the side wall through which particles of solid matter of predetermined maximum size deposited in the trap chamber can migrate forwardly into the separator chamber.

6. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber, and wherein the cone is fixed to and carried by

the tail pipe and is related to the side wall whereby clearances occur between the outer periphery of the cone and the side wall through which particles of solid matter of predetermined maximum size deposited in the trap chamber can migrate forwardly into the separator chamber.

7. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber, said front wall being radially outwardly and axially rearwardly inclined and adapted to redirect the radially outwardly moving gases axially rearwardly, and wherein the cone is fixed to and carried by the tail pipe and is related to the side wall whereby clearances occur between the outer periphery of the cone and the side wall through which particles of solid matter of predetermined maximum size deposited in the trap chamber can migrate forwardly into the separator chamber.

8. A structure as set forth in claim 1 wherein said baffle defines a flat, rearwardly disposed surface spaced forward of the forward open end of the tail pipe and forward of the directing cone and upon which radially inwardly and forwardly cyclonically moving gases in the separator chamber impinge and are directed axially rearwardly into and through the tail pipe.

9. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber, said baffle defining a flat, rearwardly disposed surface spaced forward of the forward open end of the tail pipe and forward of the directing cone and upon which radially inwardly and forwardly cyclonically moving gases in the separator chamber impinge and are directed axially rearwardly into and through the tail pipe.

10. A structure as set forth in claim 1 wherein said baffle is larger in diameter than the neck and defines a flat, forwardly disposed surface upon which gases directed rearwardly into the receiver chamber impinge and are directed radially outwardly and backwardly into said chamber, said baffle defining a flat, rearwardly disposed surface spaced forward of the forward open end of the tail pipe and forward of the directing cone and upon which radially inwardly and forwardly cyclonically moving gases in the separator chamber impinge and are directed axially rearwardly into and through the tail pipe, the rear portion of the tail pipe being provided with a plurality of circumferentially and longitudinally spaced, radially outwardly opening apertures.

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