DYNAMIC EXHAUST TIP

Inventors: Nicholas Charles Field, Houston, TX (US); Richard William Ford, Houston, TX (US)

Correspondence Address:
STREETS & STEELE
13831 NORTHWEST FREEWAY
SUITE 355
HOUSTON, TX 77040 (US)

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ABSTRACT

An exhaust tip assembly including a cylindrical collar adapted to be secured to the distal end of a vehicular exhaust pipe and to extend beyond the distal end of the exhaust pipe. A rigid support structure is secured inside the collar and a turbine is rotatably coupled on the distal side of the rigid support structure. In a preferred embodiment, the turbine is concentric with the collar and has a fixed axial position adjacent the distal end of the cylindrical collar. It is also preferred for the turbine to form a plurality of vanes facing the distal end of the exhaust pipe such that exhaust gases pass over the vanes and cause the turbine to freely spin in one direction. It is further preferred if the turbine is free to continue spinning independent of exhaust gases continuing to exit the exhaust pipe through the collar.
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BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to novelty exhaust tips having an exhaust-driven spinning element.

2. Background of the Related Art

An exhaust tip is an ornamental assembly for an exhaust pipe. Typically, an exhaust tip is made of metal and/or chrome plated to match other ornamental components of the vehicle. The exhaust tip covers the bare steel exhaust pipe or tail pipe that can become rusty and covered in dirt and grease. Exhaust tips are intended to be readily viewable and generally provide a distinctive appearance to a vehicle.

The broad general appeal and interest in vehicles has led to a large and growing industry of parts and services to customize vehicles. Some parts and services are directed solely at improving vehicle performance, while other parts and services are directed solely at providing a unique ornamental appearance. Some parts and services may even provide a combination of improved performance and ornamental appearance. Still, the selection of parts and services for a vehicle can be extremely personal and expressive.

Therefore, there continues to be a demand for further ornamental devices for a vehicle. It is desirable to provide ornamental devices for a vehicle that do not deter the performance of the vehicle and are easy to install and maintain.

SUMMARY OF THE INVENTION

The present invention provides an exhaust tip assembly, comprising a cylindrical collar adapted to be secured to the distal end of a vehicular exhaust pipe and to extend beyond the distal end of the exhaust pipe. A rigid support structure is secured inside the collar and a turbine is rotatably coupled on the distal side of the rigid support structure. In a preferred embodiment, the turbine is concentric with the collar and has a fixed axial position adjacent the distal end of the cylindrical collar. It is also preferred for the turbine to form a plurality of vanes facing the distal end of the exhaust pipe such that exhaust gases pass over the vanes and cause the turbine to freely spin in one direction. It is further preferred if the turbine is free to continue spinning independent of exhaust gases continuing to exit the exhaust pipe through the collar. The most preferred turbine includes a rim that gives the turbine the shape of a wheel with a plurality of spokes. Other aspects of the preferred embodiments are described below with reference to the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

So that the above recited features and advantages of the present invention can be understood in detail, a more particular description of the invention, briefly summarized above, may be had by reference to the embodiments thereof that are illustrated in the appended drawings. It is to be noted, however, that the appended drawings illustrate only typical embodiments of this invention and are therefore not to be considered limiting of its scope, for the invention may admit to other equally effective embodiments.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 is a perspective view of an exhaust tip assembly mounted to an exhaust pipe.

FIG. 2 is cross-sectional side view of the exhaust tip assembly mounted to an exhaust pipe.

FIG. 3 is a back view of the exhaust tip assembly.

FIG. 4 is a front view of the exhaust tip assembly.

FIG. 5 is a cross-sectional view of a single vane of a turbine.

FIGS. 6A-D are cross-sectional views of alternative vanes.

FIG. 7 is a plan view of an embodiment of a turbine in the form of a wheel.

FIG. 8 is a plan view of an embodiment of a turbine without a rim.

FIGS. 9A-C are schematic views of alternative embodiments of a structure for supporting a turbine within the collar.

FIG. 9D is a schematic side view of the embodiment of FIG. 9C.

FIG. 10 is a cross-sectional side view of an exhaust tip assembly mounted to an exhaust pipe and having a support structure with fins that cause the exhaust gases to swirl.

FIG. 11 is a back view of the exhaust tip assembly illustrating the fins and the turbine.

The assembly 10 also includes a turbine in the shape of a wheel 18 that is rotatably coupled to the collar 14 so as to spin as exhaust gases are pushed through the wheel. The collar 14 and wheel 18 are preferably both cylindrical and concentric. The wheel 18 includes a rim 20, hub 22, and spokes 24. The outwardly visible, downstream face of wheel 18 forms a display surface that may be contoured and designed for aesthetic appeal, including, for example, point 26 and grooves 28. The preferred display face is generally flat or gently curved and may include grooves or other ornamentation. It is desirable for the appearance to be similar to that of a hub-cap. Accordingly, the display surface of individual spokes may be generally symmetrically contoured.

FIG. 23 is cross-sectional side view of the exhaust tip assembly 10 mounted to an exhaust pipe 12. As shown, the transitional section 16 of the collar 14 has been coupled
to the exhaust pipe 12 by a circumferential weld 30. At the distal end of the collar 14, a support structure 32 is secured to the inside surface 34 of the collar 14 and extends into the axial center of the collar 14. A rotary bearing or bushing 36 is secured to the support structure 32 and rotatably couples a shaft 38 that is part of, or attached to, the turbine wheel 18. Accordingly, the wheel is rotatably secured to the collar 14 in a fixed axial position, such as immediately inside the distal end of the collar. The present embodiment illustrates the optional feature of the collar 14 having a rolled distal end 40, which may overlap the rim 20 of the wheel 18. It is believed that the overlapping may reduce the amount of exhaust gas passing through the generally annular gap 42 formed between the perimeter of the wheel and the collar and allow more of the exhaust gas to be utilized in spinning the wheel.

[0024] FIG. 3 is a back view of the exhaust tip assembly 10. The support structure 32 of this embodiment extends across the full inside diameter of the collar 14 and is secured to both sides. The preferred support structure 32 includes a central hole 44 for passage of the shaft 38 and holes 46 along the length of the structures 32 to reduce the extent that the structure will block exhaust gas. The wheel 18 rotates about the axial center 48 of the bearing or bushing 36. Preferably, there is only a small annular gap 42 between the wheel 18 and the collar 14.

[0025] As shown in FIG. 3, it can be appreciated that the support 32, wheel 18 and rolled end 40 are obstructions that reduce the extent of the cross-sectional area of the collar is open for the passage of exhaust gases. However, the collar may be considered to have an effective cross-sectional area that is the sum of the cross-sectional areas that are not blocked at any given point in the rotation of the wheel 18. In the embodiment of assembly 10, the effective cross-sectional area of the collar is substantially the sum of the five openings between the spokes 24, less some portion of the structural support 32 that may further block these openings. If the collar does not have rolled ends, then the effective cross-sectional area may also include the area of the annular gap 42. Accordingly, it is preferred that the effective cross-sectional area of the collar is approximately equal to, or greater than, the cross-sectional area of the exhaust pipe so as to avoid forming a restriction that might affect engine performance. This is possible because the collar has a greater diameter than the exhaust pipe.

[0026] FIG. 4 is a front view of the exhaust tip assembly 10. Here, the optional rolled end 40 of the collar 14 overlaps with, and hides, most of the rim 20 (see FIG. 2). While the structural support 32 can be seen in the front view of this embodiment, it is preferred to reduce the prominence of the support so that is does not detract from the appearance of the display face of wheel 18. For example, the wheel 18 preferably has a shiny, metallic surface, such as silver, gold or chrome plate. The support 32 is preferably a dark color, most preferably a matte black. Furthermore, the positioning of the support behind the wheel 18 tends to limit its exposure and puts it in the shadows of the wheel 18 and collar 14.

[0027] FIG. 5 is a cross-sectional view of a single spoke 24 of a wheel 18 adjacent a rolled end 40 of the collar. The spoke 24 of this embodiment includes a proximal surface 50 that forms a vane. This particular vane has a flat surface 50 that is radially slanted and exposed to a generally axial flow of the exhaust gases in the direction of arrows 52. While the exhaust gases are deflected around the spoke 24 in the direction of arrow 54, the spoke is urged radially in the direction of arrow 56 causing the wheel to rotate about the axis 48. Consequently, it should be recognized that the fixed physical configuration of the vane or vanes determines the direction in which the wheel will spin.

[0028] FIGS. 6A-D are cross-sectional views of alternative embodiments of spokes 24 having proximal surfaces that form vanes for imparting rotation to the wheel in a similar manner. FIG. 6A, the spoke embodiment 24A has a proximal surface 58 that, while not slanted, preferentially allows exhaust gases to flow around one side more readily than around the other side, thereby imparting rotation. In FIG. 6B, a triangular block or bar 60 has been attached to the proximal side of the otherwise flat spoke embodiment 24B.

This embodiment simplifies the construction of the spoke 24B, but requires the attachment of the block 60. Such attachment may include welding, adhesives or screws. In FIG. 6C, the spoke 24C also has an attached block or bar 62 having a different configuration. In FIG. 6D, the spoke 24D has a proximal surface with an irregular curvature that generally slants in one direction to similarly impart rotation. These embodiments are exemplary and should not be taken as limiting the scope of the invention. However, it is preferred that the spokes have a generally uniform appearance from the front view (as in FIG. 4).

[0029] FIG. 7 is a plan view of the back side of the wheel-shaped turbine 18. In this embodiment, the vanes 50 are shown machined from a portion of the back surface of the spokes 24. FIG. 7 is consistent with FIG. 5 and shows the direction of spinning by arrow 56.

[0030] FIG. 8 is a plan view of another embodiment of a turbine 66 that would function in substantially the same manner as the wheel 18 shown in FIG. 7. The primary difference is that the turbine 66 does not have a rim. The use of a rim is presently preferred because of the strength it adds to the spinning member and because of the flywheel effect that the rim provides.

[0031] FIGS. 9A-C are schematic back views of alternative embodiments of support structures for securing a turbine within the collar 14. These views are similar to the back view shown in FIG. 3. For clarity, the turbine wheel 18 has been left out. Accordingly, FIG. 9A shows the support 32 as shown in FIG. 3 with a central hole 44 for receiving the shaft 38. It is anticipated that the hole 44 may be omitted by securing the bushing or bearing 36 to the front face of the support 32 and terminating the shaft within the bushing or bearing. In FIG. 9B, a support 68 includes three legs 70, preferably at equiangular spacing. A support with any number of legs could be envisioned. However, FIG. 9C shows a support 72 having a single leg from the axial center 48 to the side of the collar 14. This support 72 is advantageous in maintaining more open area for the flow of exhaust gases through the collar. While support 72 might otherwise be less rigid that the other supports 32, 70, FIG. 9D (a schematic side view of the embodiment of FIG. 9C) shows a brace 74 that can be used to strengthen the support. Many alternative supports can also be imagined that are within the scope of the present invention.

[0032] FIG. 10 is a cross-sectional side view of another embodiment of an exhaust tip assembly 80 mounted to an
exhaust pipe 12 and having a support structure 82 with fins 84 that cause the exhaust gases 88 to deflect and swirl before reaching the turbine, such as wheel 18. The swirling exhaust gas then drives the wheel 18. While this embodiment may function without regard to the profile of the spoke 24 or vane surface 50, the swirling exhaust gases may be most effective in driving a vane of the type shown in FIGS. 6A or 6B if the swirling gases are directed by the fins 84 against the projecting walls 86. Many alternative fin and vane designs can also be imagined that are within the scope of the present invention.

[0033] FIG. 11 is a back view of the exhaust tip assembly 80 shown in FIG. 10, illustrating the fins and the rotational direction of the wheel 18. The exhaust gases flow down the exhaust pipe 12 and down the collar 14 (into the page as shown in FIG. 11) before being deflected by the fins 84. The exhaust gases flow in direction 88 and push against the side of the wall 86 or even the spoke 24 itself.

[0034] In operation, the embodiments described above perform in a similar manner. Upon ignition of the vehicle engine, exhaust gases begin to flow through the exhaust pipe and the collar. Depending on the amount of friction in the bearing or bushing that rotatably supports the shaft of the wheel and the size, number and pitch of the vanes, the wheel may begin spinning either under engine idling conditions or begin only upon the engine reaching higher rotations per minute or other engine conditions producing a higher exhaust gas flow rate. In one embodiment, the friction is as low as possible to encourage spinning even at low exhaust gas flow rates and to maximize the spinning rate at higher flow rate. A low frictional bearing or bushing will also increase the extent of continued spinning after the exhaust gas flow has declined or stopped. Having the wheel continue to spin after the engine is shut off or vehicle movement has stopped is highly desirable. Still, in another embodiment, the friction in the bearing or bushing may be slightly greater in order to keep the spinning rate within a range that increases viewability. It is anticipated that the wheel may reach such high spin rates that any detail or light reflective surface features of the wheel may become blurred to the point that the visual effect is diminished. Consequently, friction may be used to regulate the spin rate to a desirable range over the intended driving conditions. Still further, the spin rate will affect the sound of the exhaust. In some applications, the dynamic exhaust tip delivers a “whirring” sound characteristic of a turbocharger. It is believed that the spinning turbine or “wheel” could potentially improve the exhaust flow, resulting in lower exhaust backpressure and thereby increasing performance and/or fuel economy.

[0035] The term “shaft” means a supporting member that carries a wheel and either rotates with the wheel or allows the wheel to rotate freely on it. The term “vane” means a flat or curved surface exposed to a flow of fluid so as to be forced to move or to rotate about an axis. The term “turbine” means a bladed or vaned device that rotates on a shaft and is actuated by the reaction to a current of fluid. The term “fin” means a fixed structure having a flat or curved surface exposed to a flow of fluid so as to impart a swirling direction to the fluid. References to a turbine in the shape of a “wheel” mean a turbine, as defined above, that includes a circular frame with a hub at the center for attachment to a shaft, about which it may revolve.

[0036] This description is intended for purposes of illustration only and should not be construed in a limiting sense. The scope of this invention should be determined only by the language of the claims that follow. The terms “comprising,” “including,” and “having,” as used in the claims and specification herein, shall be considered as indicating an open group that may include other elements not specified. The term “consisting essentially of,” as used in the claims and specification herein, shall be considered as indicating a partially open group that may include other elements not specified, so long as those other elements do not materially alter the basic and novel characteristics of the claimed invention. The terms “a,” “an,” and the singular forms of words shall be taken to include the plural form of the same words, such that the terms mean that one or more of something is provided. For example, the phrase “An assembly comprising a wheel” should be read to describe an assembly having one or more wheels. The term “one” or “single” shall be used to indicate that one and only one of something is intended. Similarly, other specific integer values, such as “two,” are used when a specific number of things is intended. The terms “preferably,” “preferred,” “prefer- er,” “optionally,” “may,” and similar terms are used to indicate that an item, condition or step being referred to is not a required feature of the invention in its broadest form.

What is claimed is:

1. A dynamic exhaust tip assembly, comprising:
   a cylindrical collar adapted to be secured to the distal end of a vehicular exhaust pipe and to extend beyond the distal end of the exhaust pipe;
   a rigid support structure secured inside the collar;
   a turbine rotatably coupled on the distal side of the rigid support structure, wherein the turbine is concentric with the collar and has a fixed axial position adjacent the distal end of the cylindrical collar; and wherein the turbine forms a plurality of vanes facing the distal end of the exhaust pipe such that exhaust gases pass over the vanes and cause the turbine to freely spin in one direction.

2. The assembly of claim 1, wherein the cylindrical collar has a distal end having a diameter that is greater than the diameter of the distal end of the exhaust pipe.

3. The assembly of claim 1, wherein the turbine is free to continue spinning independent of exhaust gases continuing to exit the exhaust pipe through the collar.

4. The assembly of claim 1, wherein the turbine forms a wheel having a rim and a plurality of spokes.

5. The assembly of claim 4, wherein the plurality of vanes are formed on upstream faces of the plurality of spokes.

6. The assembly of claim 5, wherein the wheel has a downstream face that is not the mere complement of the upstream face.

7. The assembly of claim 6, wherein the downstream face forms a display surface.

8. The assembly of claim 7, wherein the display surface is substantially planar.

9. The assembly of claim 4, wherein the wheel has an outer diameter that defines a gap between the wheel and the collar, and wherein the area of the gap is less than the open area between the spokes of the wheel.
10. The assembly of claim 1, characterized in that the exhaust gases cause the turbine to spin independent of the exhaust pipe orientation.

11. The assembly of claim 1, wherein the turbine is made of metal.

12. The assembly of claim 1, wherein the turbine is rotatably coupled to the rigid support structure by a sealed bearing that is resistant to exhaust gas operating temperatures.

13. The assembly of claim 1, wherein the spinning of the turbine alters the sound of the exhaust.

14. The assembly of claim 1, further comprising:

   a plurality of fins secured within the collar proximal to the turbine for imparting a swirling motion to the exhaust gases.

15. The assembly of claim 14, wherein the fins form the rigid support structure.

16. The assembly of claim 1, wherein the distal end of the collar is rolled inward.

17. The assembly of claim 16, wherein the rolled end of the collar overlaps the downstream face of the turbine.

18. The assembly of claim 1, wherein the effective cross-sectional area of the collar is approximately equal to or greater than the cross-sectional area of the exhaust pipe.

19. The assembly of claim 1, further comprising a vehicular exhaust pipe, wherein the cylindrical collar is secured to the distal end of a vehicular exhaust pipe and extends beyond the distal end of the exhaust pipe.

20. The assembly of claim 19, further comprising a vehicle having an internal combustion engine operatively coupled to the vehicular exhaust pipe.

21. The assembly of claim 1, wherein the turbine is rotatably coupled to the rigid support structure by a bushing that is resistant to exhaust gas operating temperatures.