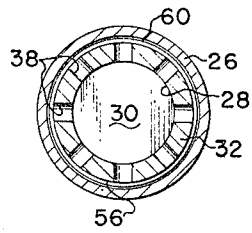
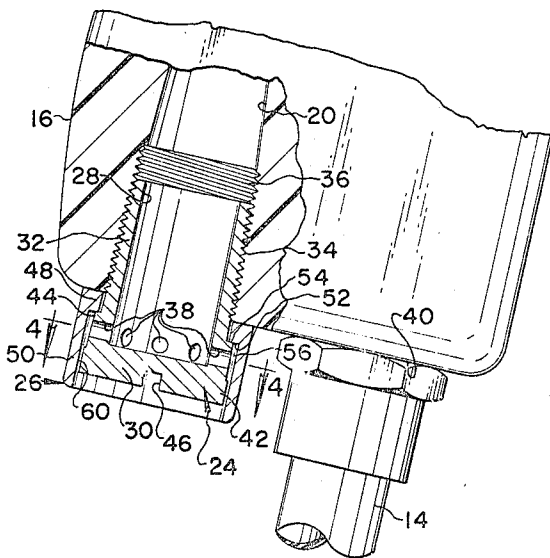
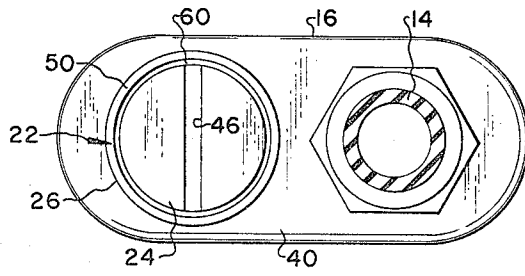
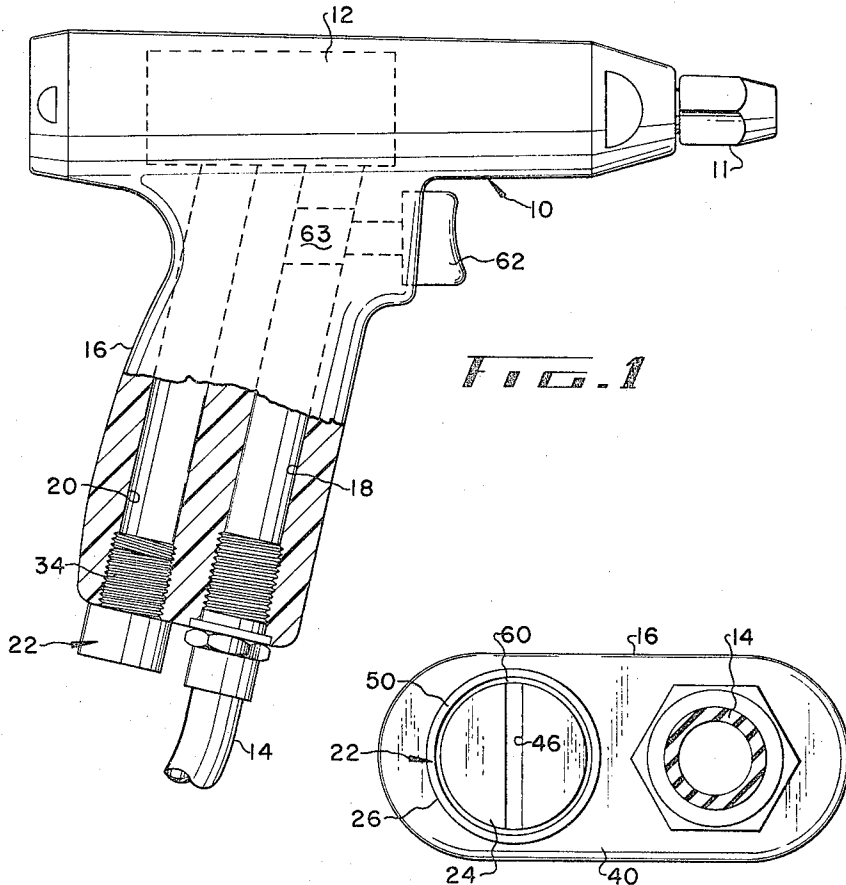


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EXHAUST MUFFLER FOR PNEUMATIC TOOL

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1

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EXHAUST MUFFLER FOR PNEUMATIC TOOL
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ABSTRACT OF THE DISCLOSURE

A noise muffling attachment for the exhaust outlet of an air motor-operated tool comprising a hollow plug having exhaust air flow apertures opening radially from its interior and a tubular sleeve coaxially disposed about the exterior of the plug for collecting and directing the exhaust for final discharge through an annular orifice defined between the plug and the sleeve.

Background of the invention

Air tools of the type driven by rotary air motors usually display undesirable noise characteristics due to the pulsating flow of high pressure air from the motor exhaust to atmosphere. In pistol-grip hand tools, it is common to exhaust motive air through the handle portion of the tool as shown in U.S. Patent No. 2,966,138 issued to Quackenbush and U.S. Patent No. 3,299,781 issued to Law. Both of these prior patents provide noise muffling means associated with the handle exhaust passage. Quackenbush suggests placing muffling means inside the handle passage; and Law shows a muffling device closing the exhaust passage and extending beyond the bottom of the handle. U.S. Patent 2,950,775 issued to Zwyer also discloses an external muffling device which is fitted into the bottom of a handle grip for receiving exhaust air from an exhaust passage in the handle. In each of the above identified patents, the noise muffling action is generally accomplished by some diffuser means for breaking up the exhaust flow stream into a large number of randomly directed streams. For this purpose, muffling elements generally comprise porous metal filters, interwoven screens, baffles, fibrous packings, porous rubber plugs, and the like. While all of these materials will produce noise muffling, it is difficult, if not impossible, to produce and maintain substantially uniform, predeterminable effects on the exhaust air as the latter flows through the muffling material because of changes in the density of compactable materials and random changes in flow characteristics, such as induced turbulence, of the exhaust stream as the latter passes through structurally deformable screens and baffles. Such nonuniformity in the flow of high pressure air through conventional mufflers frequently produces undesirable variations in the noise attenuating characteristic of the muffler and in the pressure drop across the muffler. It is an object of this invention to eliminate, or at least greatly reduce, such variations so that certain preset optimum operational characteristics of air tool mufflers can be maintained.

Summary of the invention

The invention resides in the combination of an air-operated tool with an exhaust muffler device which is attachable to the tool casing between the air motor of the tool and atmosphere. The muffler device is very simply and cheaply made of a hollow plug having one end detachably threaded into an exhaust outlet passage of the tool handle and a tubular sleeve disposed about the plug in coaxial relation therewith. The sleeve and plug are made of metal or other rigid material of low porosity. The interior cavity of the plug opens near one end through a plurality of radially bored, angularly spaced apertures

2

of predetermined size, shape and number to produce omnidirectional, lateral diffusion of the exhaust air stream. The surrounding sleeve is coaxially spaced with respect to the plug to define an elongated annular exhaust-receiving chamber between the plug and the sleeves which opens through an annular orifice to the exterior of the tool casing. In its assembled condition, an internal flange of the sleeve is clamped between the plug and the tool casing to close one end of the exhaust-receiving chamber and to insure that the facing walls of the plug and the sleeve are coaxially spaced along the full length of the orifice thereby providing a fixed orifice of uniform radial dimension for the final efflux of exhaust air to atmosphere. Since the sleeve and plug are fabricated of rigid material and the apertures in the plug and the orifice defined between the sleeve and plug are fixed in size and shape, the air flow characteristics of this muffler device will remain constant whereby optimum preset noise attenuation and pressure drop through the muffler will not vary due to air pressure induced compaction of muffler material or deformation of muffler parts.

These and other objects of the invention will become apparent upon reading the following description and claims in connection with the attached drawings in which:

FIGURE 1 is a side view of an air motor-operated tool having a portion of the casing broken away;

FIG. 2 is an enlarged fragment of the casing handle shown in FIG. 1 with the muffler device shown in section;

FIG. 3 is an enlarged bottom view of the handle shown in FIG. 1; and

FIG. 4 is a section taken along lines 4—4 of FIG. 2.

In the drawings, the numeral 10 generally designates the casing of a hand-held, pistol-grip tool of the air motor-actuated type which is commonly employed as a drill, impact wrench, nut-setter, screw driver, wire wrapper and the like. The output spindle 11 of the tool is rotatively driven by a motor 12 housed in the casing 10 and to which high pressure motive air is supplied by means of a conduit 14 attached to the casing handle 16 and by an air inlet passage 18 in the handle which communicates with the air inlet port of the motor 12. Sliding vane motors are commonly employed with hand-held tools of the aforedescribed type and, if such a motor is permitted to exhaust directly to atmosphere, roaring or whining is created due to the pressure variations or pulsations in the exhaust air. However, in accordance with this invention such objectionable noise is reduced or eliminated since the motor exhaust is expelled through an exhaust passage 20 in the handle and then through an exhaust muffler, indicated generally by numeral 22.

The muffler 22 comprises a generally cylindrical plug member 24 and a tubular sleeve 26 which telescopingly surrounds a portion of the plug in spaced relation thereto. The plug 24 is provided with a central cavity 28 opening upwardly and closed at the bottom by a wall 30 which defines the lower end of the plug. A major portion of the length of the wall 32 of the plug is provided with external threads 34 which engage with mating internal threads 36 formed in the lower portion of the exhaust passage 20.

A plurality of apertures 38 open through the plug wall 32 to the cavity 28 in that portion of the plug wall which extends downwardly beyond the bottom surface 40 of the tool handle 16. As shown in FIG. 4, the apertures open radially through the plug wall and are angularly spaced at even intervals from one another with the longitudinal axes of the apertures lying in a common plane at a right angle to the longitudinal axis of the cavity 28. A portion of the plug end wall 30 is provided with an enlarged annular flange 42; and, the apertures 38 open above the flange 42 to the exterior surface 44 of the plug wall 32. As best shown in FIG. 3, a transverse slot 46 is relieved in the bottom surface of the plug end wall 30 for engagement

by a suitable implement for rotating the plug 24 to assemble or disassemble the threads 34 and 36.

The aforementioned sleeve 26 includes a radially inwardly extending annular collar or flange 48 and a depending tubular skirt 50. The internal diameter of the collar 48 is sized so that the threaded upper end of the plug 24 may be inserted upwardly thereinto until the bottom surface 52 of the collar bears upon an annular shoulder 54 which projects from the wall 32 of the plug 24 in the manner shown in FIG. 2. When the plug threads 34 are in full engagement with the threads 36 in passage 20, the collar 48 is rigidly clamped between the plug shoulder 54 and the bottom handle surface 40. Thus, when the plug 24 is properly attached to the handle 16 by the engagement of the threads 34 and 36, as shown in FIG. 2, the sleeve 26 is clampingly secured in assembled relation with the plug 24 and the handle 16 so that the skirt 50 is coaxial with and spaced from the plug. As a result, an annular exhaust-receiving chamber 56 is defined between the wall 44 and the inner skirt wall 58; and, an annular orifice 60 is defined between facing surfaces of the plug bottom wall 30 and the inner cylindrical wall of the skirt 50. For a purpose to be more fully disclosed, it is preferable that the aforescribed clamping of the sleeve collar 48 will rigidly secure the sleeve 26 and plug 24 to the handle 16 to provide the orifice 60 with a cross section of substantially uniform radial dimension.

Preferably, the plug and sleeve which make up the muffler 22 are simply and inexpensively fabricated from steel or other metal having high strength, particularly good resistance to bending or denting due to impacting. However, certain engineering-grade plastic materials offering good dimensional stability and high impact strength are acceptable.

In the operation of the illustrative tool, the motor 12 is energized by depressing a trigger 62 which opens a suitable valve 63 in the air inlet passage 18 to admit motive air to the motor 12. Exhaust air is expelled from the motor 12 through the exhaust passage 20 into the plug cavity 28, through the apertures 38 into the chamber 56, and, finally, through the annular orifice 60 to atmosphere. The radially directed apertures 38 cause the exhaust air to change direction abruptly and to be broken up or diffused into a plurality of streams thereby damping the sound pressure variation in the air flow and changing the flow pattern of the exhaust air to produce noise attenuation. The exhaust air is then collected or recombined in the exhaust chamber 56; and, with another change in direction of flow, the sound pressure variations are further damped and the air is then emitted through the orifice 60 to the exterior of the casing 10. The skirt 50 may be extended as desired beyond the bottom of the plug 26 to directionalize more highly the exhaust flow from the orifice 60 if this should be advantageous in certain tool applications.

The sound attenuating characteristic of the muffler 22 is predeterminable primarily by relating the size, shape and number of the apertures 38 to the volume and velocity of the air entering the cavity 28. The pressure drop across the muffler 22 is primarily determined by the annular area of the fixed orifices 60. In accordance with this muffler construction, it is possible to preselect a desirable combination of sound attenuation and motor back pressure; and, because the muffler comprises only rigid, fixed parts, these preselected characteristics will not be subject to those objectionable variations commonly encountered in conventional mufflers of the type described hereinabove. Thus, an outstanding feature of this invention is that the motor speed of the illustrative tool is not affected by fluctuation in muffler induced back pressure; and, the sound of the muffled exhaust stream is not subject to annoying changes in pitch and volume due to physical changes in the structure of the muffler parts and resulting changes in the exhaust flow pattern or speed of exhaust flow through the muffler.

In the normal usage of hand-held air tools, it may be expected that the muffler 22 will be subjected to random impacting and that the muffler may be disassembled and reassembled for periodic inspections. Such impacting and reassembly tend to cause the connection between threads 34 and 36 to become loose due to thread deformation and wear; therefore, it is possible that the plug 24 will not threadably engage with the handle 16 to properly clamp the sleeve 26 in the hereinbefore described manner. As a result, the sleeve 26 may shift or wobble out of coaxial alignment with the plug 24 so that an optimum preset size and shape of the orifice 60 can no longer be maintained with the attending bad results that the exhaust flow through the orifice may produce extraneous noise and the pressure drop across the muffler may vary. These possible bad results do not occur in the muffler 22, however, due to a self-centering action of the sleeve 26 about the longitudinal axis of the plug 24. Thus the exhaust air will be emitted from the plug apertures 38 in an omnidirectional manner and will traverse the annular orifice 60 at substantially the same pressure and velocity at all points around the circumference of the orifice 60. However, should the sleeve 26 drift laterally causing the orifice 60 to lose its uniform cross sectional shape, well understood dynamic and static pressure effects will operate on the skirt 50 to shift the skirt back into the desired coaxial relation with the plug 24.

Another important feature of this invention is the provision of an air tool muffler which is simply constructed and easy to assemble. In this regard it will be appreciated that the muffler 22 comprises only two interfitting parts, the plug 24 and the sleeve 26, which are unlikely to be improperly assembled by inexperienced or careless workers. Moreover, when the muffler is initially assembled or when it is reassembled following inspection or repair, the tool may be energized briefly, just prior to finally tightening of the threads 32 and 34, so that the sleeve 26 will center itself in the manner described above, and the sleeve can thereupon be finally clamped between the plug 26 and the handle 16 so that the orifice 60 is properly defined.

Another advantage of the muffler 22 is that its assembled length and its diameter are such that the muffler can be externally attached to the bottom surface 40 of the tool handle 16 without excessive protrusion below the handle and without extending beyond the side surfaces of the handle. It will also be appreciated that by employing the plug 24 to clamp the sleeve 26 in place, the plug can be readily threaded into proper relation with the handle 16 by a standard screwdriver which is engageable in the slot 46. This is an extremely advantageous method of assembly for the muffler 22 since, as shown in FIG. 3, the muffler 22 and a fitting 62 for the air line 14 are necessarily closely spaced and it would be difficult to apply a wrench radially to the wall of the sleeve 26.

It will be apparent to those skilled in the art that various changes in construction, proportion and arrangement of the described tool muffler may be made without sacrificing any of the advantages of the invention or departing from the scope of the pending claims.

Having fully described the invention, we claim:

1. In combination:

(a) a pneumatic tool comprising:

- (1) casing means including a handle portion;
- (2) air motor means housed by said casing means;
- (3) air supply passage means and exhaust passage means defined by said casing means and communicating with said motor means, said exhaust passage means extending through said handle portion and opening to the exterior of said casing means; and

(b) exhaust muffler means attached to said casing means in communication with said exhaust passage means and comprising:

- (1) a hollow member having a cavity for receiving exhaust from said exhaust passage and hav-

- ing a portion secured to said handle portion in the opening of said exhaust passage;
- (2) a tubular member disposed about the exterior of said hollow member and defining exhaust discharge means therebetween; 5
- (3) said hollow member having aperture means therein communicating said cavity and said discharge means; 5
- (4) said hollow member and said tubular member defining surface means engageable to limit relative axial movement therebetween in one direction; 10
- (5) said tubular member having an annular end surface abutting with said handle portion about said opening of said exhaust passage means; and 15
- (6) said tubular member being axially clamped at one end between said handle portion and said hollow member in coaxial relation with the latter as the result of securing said hollow member to said handle portion. 20
2. The combination according to claim 1, wherein:
- (a) said hollow member and said handle portion are provided with engageable threads; and
- (b) said hollow member includes an end wall defining means cooperable with an implement operable to produce engagement of said threads whereby said hollow member and said handle portion are secured together. 25
3. In combination:
- (a) a pneumatic tool comprising: 30
- (1) casing means;
- (2) air motor means housed by said casing means;
- (3) air supply passage means and exhaust passage means defined by said casing means and communicating with said motor means; and 35
- (b) exhaust muffler means attached to said casing means in communication with said exhaust passage means and comprising:
- (1) a hollow member having a cavity for receiving exhaust from said exhaust passage; 40
- (2) a tubular member disposed about the exterior of said hollow member and defining exhaust discharge means therebetween;
- (3) said hollow member having aperture means therein communicating said cavity and said discharge means; 45
- (4) said exhaust discharge means including an annular orifice opening between the exterior of said hollow member and the interior of said tubular member to atmosphere; and 50
- (5) said tubular member being rigidly spaced from said hollow member to provide said annular orifice with a uniform radial dimension about its entire perimeter. 55
4. In combination:
- (a) a pneumatic tool comprising: 55
- (1) casing means;
- (2) air motor means housed by said casing means;
- (3) air supply passage means and exhaust passage means defined by said casing means and communicating with said motor means; and 60
- (b) exhaust muffler means attached to said casing means in communication with said exhaust passage means and comprising:
- (1) a hollow member having a cavity for receiving exhaust from said exhaust passage; 65
- (2) a tubular member disposed about the exterior of said hollow member and defining exhaust discharge means therebetween;
- (3) said hollow member having aperture means therein communicating said cavity and said discharge means; and 70
- (4) said tubular member being rigidly clamped between said casing means and said hollow member.

5. In combination:
- (a) a pneumatic tool comprising:
- (1) casing means;
- (2) air motor means housed by said casing means;
- (3) air supply passage means and exhaust passage means defined by said casing means and communicating with said motor means; and
- (b) exhaust muffler mean attached to said casing means in communication with said exhaust passage means and comprising:
- (1) a hollow member having a cavity for receiving exhaust from said exhaust passage;
- (2) a tubular member disposed about the exterior of said hollow member and defining exhaust discharge means therebetween; and
- (3) said hollow member having aperture means therein communicating said cavity and said discharge means;
- (4) said tubular member including a flange portion and an integral skirt portion;
- (5) said flange portion being rigidly clamped between said casing means and said hollow member; and
- (6) said skirt portion being held rigidly in coaxial alignment with said hollow portion due to the clamping of said flange portion.
6. The combination according to claim 5, wherein: said hollow member and said tubular member comprise one-piece, rigid metal members.

7. In combination:
- (a) a pneumatic tool comprising:
- (1) casing means including a handle portion;
- (2) air motor means housed by said casing means;
- (3) air supply passage means and exhaust passage means defined by said casing means and communicating with said motor means, said exhaust passage means extending through said handle portion and opening to the exterior of said casing means; and
- (b) exhaust muffler means attached to said casing means in communication with said exhaust passage means and comprising:
- (1) a hollow member having a cavity for receiving exhaust from said exhaust passage and having a portion secured to said handle portion in the opening of said exhaust passage;
- (2) a tubular member disposed about the exterior of said hollow member and defining exhaust discharge means therebetween;
- (3) said hollow member having aperture means therein communicating said cavity and said discharge means;
- (4) said exhaust discharge means including an annular orifice opening between the exterior of said hollow member and the interior of said tubular member to atmosphere; and
- (5) said tubular member being uniformly spaced with respect to said hollow member to provide said annular orifice with a uniform radial dimension about its entire perimeter.

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