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VARIABLE VOLUME EXHAUST MUFFLER FOR FLUID OPERATED TOOLS

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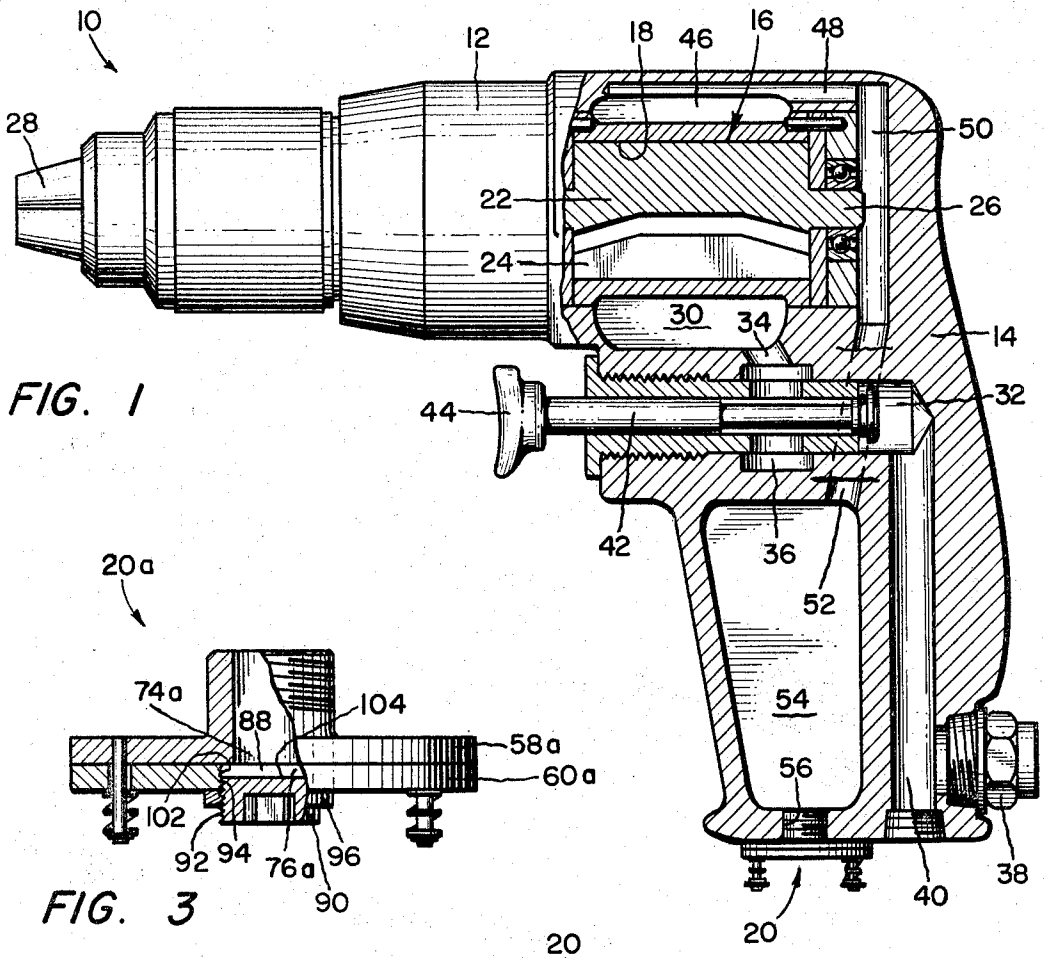


FIG. 1

FIG. 3

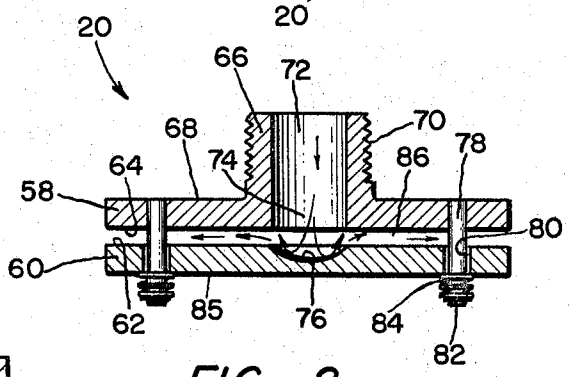


FIG. 2

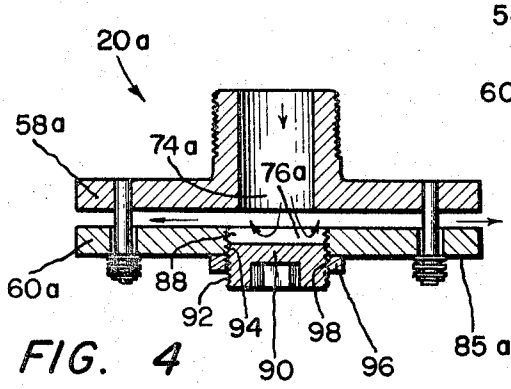


FIG. 4

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VARIABLE VOLUME EXHAUST MUFFLER FOR FLUID OPERATED TOOLS

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This invention relates to mufflers and has more specific reference to the provision of a new and improved muffler which, although particularly constructed and arranged for reducing the noise caused by fluid exhausting from a fluid operated tool such as a pneumatic tool, may be employed in many other applications for abating the noise of exhausting fluid.

Conventionally, the exhaust air discharged to atmosphere by a pneumatic tool causes considerable noise as it enters the atmosphere. This noise is primarily due to the high velocity at which the exhaust air flows into the atmosphere and the resultant turbulent mixture of the exhaust air with the atmosphere. This noise, if unabated, can be highly objectionable to the operator of the pneumatic tool and also to others in the vicinity of the pneumatic tool during its operation.

An object of the present invention is to provide a new and improved muffler which is particularly constructed and arranged for reducing the noise caused by fluid exhausting from a fluid operated tool such as a pneumatic tool.

Another object of the invention is to provide a new and improved muffler of the type set forth which is self-regulating in response to variations in the quantity of exhaust fluid which is supplied to the muffler.

Another object is to provide a new and improved muffler of the type set forth which is controllable to provide maximum noise abatement regardless of the quantity of exhaust fluid which is supplied to the muffler.

Another object is to provide a new and improved muffler of the type set forth which, although particularly constructed and arranged for employment with a fluid operated tool, is readily and simply adaptable for employment in many other applications.

The aforegoing objects, and those other objects and advantages of the invention which will be apparent from the following description taken in connection with the accompanying drawings, are attained by the provision of a muffler comprising a first plate member having an inlet opening which extends through a face of the first plate member and is adapted to be connected to an exhaust passage for receiving exhaust fluid from the exhaust passage, and a second plate member disposed adjacent the first plate member and having a face opposing said face of the first plate member. Said face of the second plate member includes a recess opposite the inlet opening in the first plate member; and means are provided for mounting the plate members such that they are relatively movable to provide a variable volume fluid passage between the opposing faces of the plate members. A means is, preferably, also provided for biasing one of the plate members towards the other of the plate members.

Referring to the drawings:

FIG. 1 is an elevational view, partially broken away and in section, of a pneumatic tool which is provided with a muffler embodying the present invention;

FIG. 2 is an enlarged, elevational view of the muffler illustrated in FIG. 1;

FIG. 3 is an elevational view, partially broken away and in section, of a muffler which is another embodiment of the invention; and

FIG. 4 is an elevational, sectional view of the muffler illustrated in FIG. 3.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout the several views, FIG. 1 illustrates a muffler 20 embodying the present invention which is operatively connected to a pneumatic tool designated generally as 10. As illustrated, the pneumatic tool 10 comprises a housing or casing which is formed to include an elongated barrel 12 and a handle 14 depending from the barrel 12. The pneumatic tool 10 is powered by a vane-type, air motor 16 which is disposed within a motor chamber 18 formed within the rearward end of the barrel 12. The air motor 16 comprises a rotor 22 carrying a plurality of vanes, one of which is shown as 24, and a rotatably journalled shaft 26 which is formed integrally with the rotor 22. The forward end of the shaft 26 is connected through suitable conventional gearing (not shown) to the tool chuck 28 to rotatably drive the latter. The tool chuck 28, as will be understood, rigidly carries the working implement (not shown) of the pneumatic tool 10 during the operation of the tool.

Pressurized air for operating the air motor 16 is supplied to the motor chamber 18 through an inlet chamber 30 which is connected to the motor chamber 18 through a bore (not shown) and which is also connected to a valve chamber 32 through a bore 34 and an annular fluid passage 36. Pressurized air is supplied to the valve chamber 32 from a pneumatic supply hose 38, operatively connected to a source (not shown) of pressurized air to receive pressurized air from such source, through a bore 40 formed within the handle 14. A valving member 42, slidably disposed within the valve chamber 32, is connected to the trigger 44 of the pneumatic tool 10 to be slidably moved to communicate the motor chamber 18 with the pneumatic supply hose 38 upon depression of the trigger 44. The valving member 42, with the trigger 44 undepressed as illustrated in FIG. 1, prevents fluid communication between the motor chamber 18 and the pneumatic supply hose 38.

Exhaust air is discharged from the motor chamber 18 through a bore (not shown) to an exhaust chamber 46 which is connected through the bores 48, 50 to a bore 52 formed within the housing circumferentially of the valve chamber 32. The bore 52 is connected to discharge exhaust air to a chamber 54 formed in the handle 14 which, in turn, discharges the exhaust air from the housing through a threaded bore 56. The muffler 20, as illustrated in FIG. 1, is connected to the bore 56 to receive the exhaust air flowing through the latter.

As illustrated in FIG. 2, the muffler 20 comprises a first circular plate or disc 58 and a second circular plate or disc 60 which is disposed adjacent the first plate 58 with a flat or planar side face 62 opposing a flat or planar side face 64 of the first plate 58. The first plate 58 is formed integrally with a centrally located, connector 66 which projects from the side face 68 of the first plate 58 remote from the second plate 60. The connector 66 is provided with a circumferential thread 70 adapted to mesh with the threads formed on the walls of the bore 56 and is constructed of dimensions suitable to permit its threaded connection in the bore 56. The muffler 20, as illustrated in FIG. 1, is detachably connected to the pneumatic tool 10 through this threaded connection of the connector 66 in the bore 56.

The connector 66 includes an inlet passage 72 which is aligned with an inlet opening 74 formed through the thickness of the first plate 58. The inlet opening 74, as will be seen from FIG. 2, is centrally located in the first plate 58 and extends through the side face 64 of the latter. The second plate 60 is provided with a centrally located, concave recess 76 directly opposite to the inlet opening 74.

The first plate 58 rigidly carries a plurality of supporting pins 78 which are arranged at arcuately spaced loca-

tions around the inlet opening 74 and project through the side face 64 towards the second plate 60. The second plate 60 includes a plurality of similarly arranged openings 80 which extend through the thickness of the second plate 60 and are each adapted to receive one of the supporting pins 78 in a fit suitable to permit slidable movement of the second plate 60 towards and away from the first plate 58. The supporting pins 78 are each formed with an enlarged end or head 82 which, with the muffler 20 assembled as shown in FIGS. 1 and 2, is disposed upon the side of the second plate 60 remote from the first plate 58. A relatively light, coil spring 84 is wrapped around each of the supporting pins 78 with its opposing ends in engagement with the head 82 of its respective supporting pin 78 and the side face 85 of the second plate 60 remote from the first plate 58. Thus, in the embodiment of the invention illustrated in FIGS. 1 and 2, the supporting pins 78 and the openings 80 cooperate to provide a means for mounting the second plate 60 for slidable movement towards and away from the first plate 58; and the springs 84 provide a means for lightly biasing the second plate 60 towards the first plate 58. However, it will be understood that the coil springs 84 may be eliminated in those applications of the muffler 20 in which the latter is inverted such that the second plate 60 is drawn towards the first plate 58 by gravity.

During the operation of the muffler 20, and in the absence of exhaust air flowing from the air motor 16 to the muffler 20, the springs 84 maintain the second plate 60 in face-to-face engagement with the first plate 58. When exhaust air flows from the air motor 16 through the aforedescribed exhaust passages in the pneumatic tool 10, however, this exhaust air is directed through the inlet passage 72 in the connector 66 and the aligned inlet opening 74 in the first plate 58 into the recess 76 in the side face 62 of the second plate 60. The exhaust air thereupon urges the second plate 60 from the first plate 58 sufficiently to form a fluid passage 86 between the opposing side faces 62, 64, whereupon the walls of the recess 76 redirect the exhaust air outwardly through the fluid passage 86. The exhaust air flowing through the fluid passage 86 is discharged from the muffler 20 along the circumferences of the plates 58, 60. The aforedescribed flow of exhaust air through the muffler 20 is illustrated schematically by the arrows shown in FIG. 2.

The extent to which the second plate 60 is moved from the first plate 58 during the aforedescribed operation of the muffler 20, and hence the flow volume of the fluid passage 86 formed between the opposing side faces 62, 64, is largely dependent upon the quantity and pressure of the exhaust air flowing through the inlet opening 74. In fact, the construction of the muffler 20 such that the fluid passage 86 automatically varies in flow volume in response to variations in the quantity and pressure of the exhaust air flowing through the inlet opening 74 is an important feature of the present invention as it enables the muffler 20 to be self-regulating to provide constant back pressure in the pneumatic tool 10. It has been discovered, however, that the flow volume of the fluid passage 86 for any particular quantity and pressure of exhaust air is dependent upon the volume of the recess 76 in the face 62 of the second plate 60. Thus, the extent to which the second plate 60 is moved from the first plate 58, and the resultant flow volume of the fluid passage 86, can be controlled to provide optimum noise reduction and back pressure for any particular quantity and pressure of exhaust air through the formation of the recess 76 of the proper volume.

FIGS. 3 and 4, wherein all parts similar to those hereinbefore described with reference to the embodiment of the invention illustrated in FIGS. 1 and 2 are designated by the reference character for their hereinbefore described similar part followed by the suffix *a*, illustrate a muffler 20*a* which is another embodiment of the present invention. The muffler 20*a*, as will be apparent from the following description, is different from the hereinbefore described muffler 20 primarily in that the former is constructed such that the volume of the recess 76*a* is readily adjustable by the operator of the pneumatic tool 10.

More specifically, an opening 88 is formed through the thickness of the second plate 60*a* opposite the inlet opening 74*a* in the first plate 58*a*. A plug member 90, preferably of greater thickness than the second plate 60*a*, is disposed within the opening 88 for preventing exhaust air from flowing through the opening 88. The plug member 90 includes a circumferential thread 92 adapted to mesh with a thread 94 formed on the walls of the opening 88 and is retained within the latter through the meshing engagement of the threads 92, 94. An annular locking ring 96, which includes a threaded bore 98 receiving the plug member 90 in meshing engagement, is located adjacent the side face 85*a* for preventing accidental adjustment of the plug member 90.

As illustrated in FIGS. 3 and 4, the recess 76*a* is defined by the walls 102 of the opening 88 and the end face 104 of the plug member 90. Thus, to adjust the volume of the recess 76*a*, the operator of the pneumatic tool 10 need merely adjust the position of the plug member 90 in the opening 88. As a result, the volume of the recess 76*a* may be adjusted to ensure that optimum noise reduction and back pressure is maintained throughout the operation of the muffler 20*a* and regardless of the quantity and pressure of the exhaust air flowing through the inlet opening 74*a*. The coil springs 84*a*, as will be understood, may be eliminated in those applications of the muffler 20*a* where the latter is inverted such that the second plate 60*a* is drawn towards the first plate 58*a* by gravity.

The operation of the muffler 20*a* illustrated in FIGS. 3 and 4 is believed to be apparent from the foregoing description taken in combination with the flow of exhaust air shown schematically by the arrows illustrated in FIG. 4.

From the foregoing it will be seen that I have provided new and improved means for accomplishing all of the objects and advantages of my invention. It will be understood, however, that, although I have hereinbefore specifically illustrated and described only two embodiments of my invention, my invention is not limited merely to these illustrated and described embodiments but also contemplates other embodiments and variations employing the teachings and concepts of my invention.

Having thus described my invention, I claim:

1. A muffler comprising:
   - a first plate member having an inlet opening which extends through a face of said first plate member and is adapted to be connected to an exhaust passage for receiving exhaust fluid from the exhaust passage;
   - a second plate member disposed adjacent said first plate member and having a face opposing said face of said plate member;
   - said face of said second plate member including a recess opposite said inlet opening in said first plate member; and
   - means for mounting said plate members such that they are relatively movable to provide a variable volume fluid passage between said opposing faces of said plate members.

2. A muffler according to claim 1, further comprising:
   - means for varying the volume of said recess in said face of said second plate member.

3. A muffler according to claim 1, further comprising:
   - said second plate member including an opening opposite said inlet opening in said first plate members; and
   - plug means disposed within said opening in said second plate member cooperating with the walls of said opening to provide said recess in said face of said second plate member and being adjustable for varying the volume of said recess.

4. A muffler according to claim 3, further comprising:
said plug means and the walls of said opening in said second plate member having mating threads.

5. A muffler according to claim 1, further comprising:
said second plate member including an opening opposite said inlet opening in said first plate member;
plug means disposed within said opening in said second plate member cooperating with the walls of said opening to provide said recess in said face of said second plate member; and
means for adjustably connecting said plug means to said second plate member such that said plug means is movable to vary the volume of said recess.

6. A muffler according to claim 5, further comprising:
means for biasing one of said plate members towards the other of said plate members.

7. A muffler according to claim 6, further comprising:
said mounting means comprising means for mounting said second plate member for movement towards and away from said first plate member; and
said biasing means comprising means for biasing said second plate member towards said first plate member.

8. A muffler according to claim 6, further comprising:
said mounting means comprising a plurality of supports connected to said first plate member and slidably supporting said second plate member for movement towards and away from said first plate member; and
said biasing means comprising a spring for biasing said second plate member towards said first plate member.

9. A muffler according to claim 6, further comprising:
said opposing faces of said plate members each being flat;
said mounting means comprising a plurality of pins carried by said first plate member and slidably supporting said second plate member; and
said biasing means comprising a spring carried by each of said pins for biasing said second plate member towards said first plate member.

10. A muffler according to claim 6, further comprising:
said plate members each being formed of circular configuration;
said opposing faces each being flat; and
said inlet opening and said opening in said second plate members being centrally located in said first and second plate members, respectively.

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