United States Patent

Hayes

[15] **3,635,299**

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[54] MUFFLER FOR PNEUMATIC TOOL

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[52] **U.S. Cl.** .....**181/36 A**, 181/57

[51] **Int. Cl.**.....**F01n 1/08**

[58] **Field of Search**.....181/36.1, 36, 35, 47, 57, 41, 181/49

[56] **References Cited**

UNITED STATES PATENTS

3,224,527	12/1965	Waldron	181/36.1
2,561,726	7/1951	Cherain	181/36.1
2,789,653	4/1957	Fannen	181/36.1
3,255,844	6/1966	Wallace	181/36.1
3,365,022	1/1968	Barber et al.	181/36.1

FOREIGN PATENTS OR APPLICATIONS

356,171	8/1931	Great Britain	181/36.1
43,968	12/1965	Germany	181/36.1
329,237	5/1930	Great Britain	181/36.1
356,864	9/1931	Great Britain	181/36.1

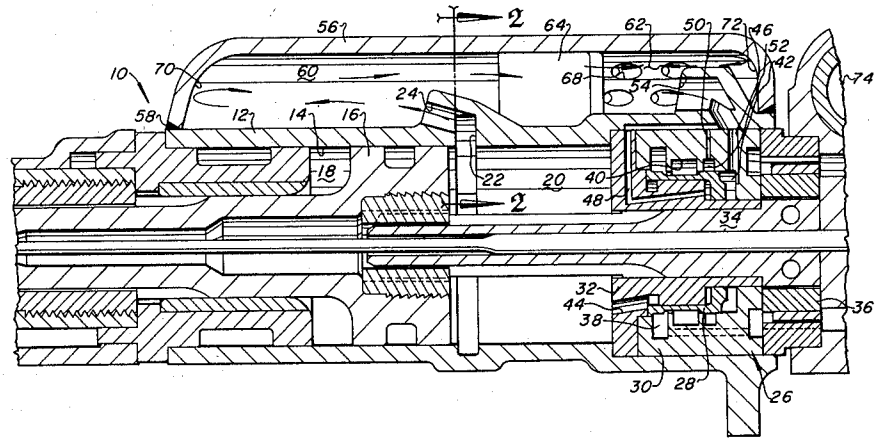
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[57] **ABSTRACT**

A muffler for a pneumatic tool of the expansible chamber percussion motor type. The muffler comprises a substantially integral shroud covering a portion of the tool casing and forming a double expansion chamber for the motive air exhausting from the percussion motor. The muffler shroud includes a plurality of openings for discharging exhaust air from the expansion chamber. Exhaust ports opening from the percussion motor into the double expansion chamber are arranged with respect to the exhaust openings in the shroud to provide substantial retroverted flow of the exhaust air upon entering and leaving the muffler. An exhaust flow stream from the percussion motor distributing valve is also introduced into one of the muffler expansion chambers and interacts with the percussion motor exhaust air to produce a synergistic noise reduction effect.

5 Claims, 3 Drawing Figures



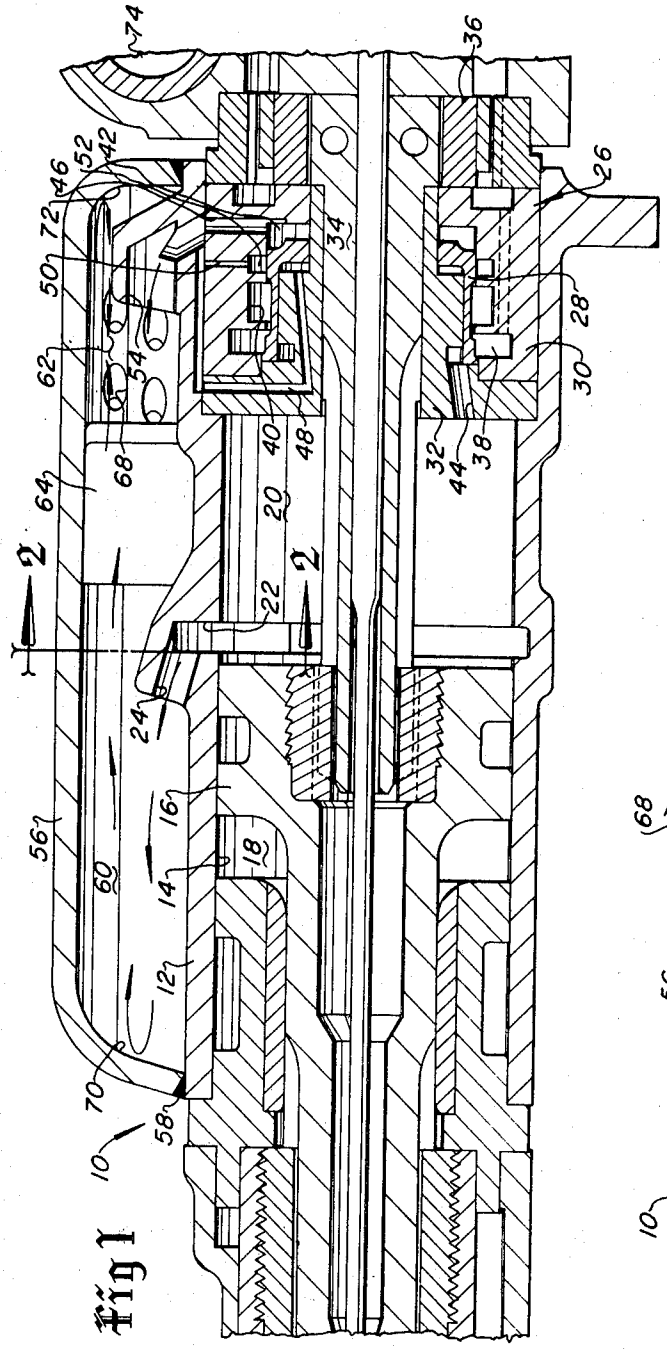


Fig 1

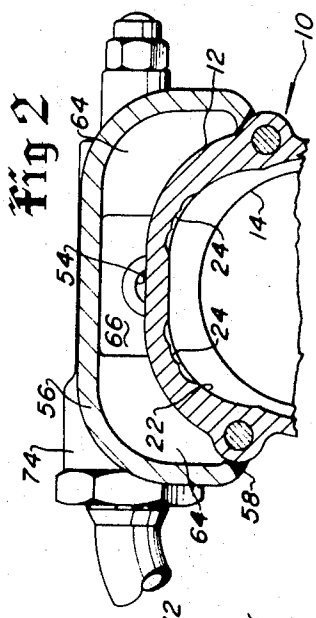


Fig 2

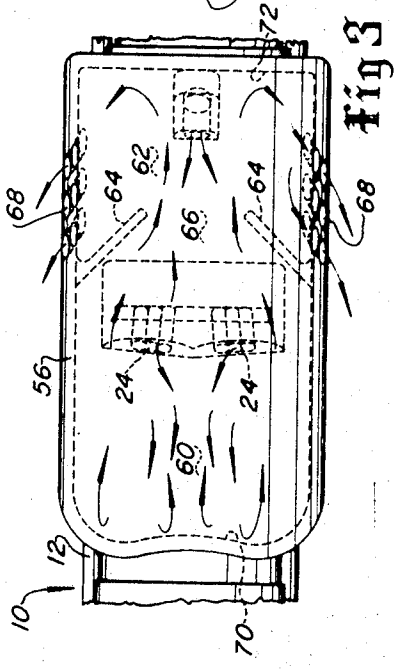


Fig 3

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MUFFLER FOR PNEUMATIC TOOL

BACKGROUND OF THE INVENTION

Noise of considerable intensity is produced by conventional pneumatic percussion tools due to the motive air exhausting from the percussion motor during its operation. Various muffler devices are known in connection with pneumatic percussion tools which combine assorted means for treating the exhaust flow stream to reduce the overall noise level of the tool. Examples of prior art muffling devices are disclosed in U.S. Pat. Nos. 3,255,844 to A. W. Wallace and 3,224,527 to R. J. Waldron. The shortcomings of most prior art muffling devices for pneumatic tools include the fact that they are structurally complicated and they add considerable bulk to the tool.

It has been determined that by controlling expansion and imparting directional changes to the flow a substantial reduction in the overall noise level produced by the exhaust air flow from pneumatic tools can be realized. However, prior art exhaust treatment devices are known to be costly to manufacture and maintain and furthermore they have largely failed to combine the principles of noise reduction in a structurally simple yet effective device.

SUMMARY OF THE INVENTION

The present invention provides for a muffler for a pneumatic percussion tool wherein effective noise reduction in a pulsating stream of exhaust air is realized by discharging exhaust air from the percussion motor into a double expansion chamber formed by a shroud around a portion of the tool casing, and by subjecting the exhaust air stream to substantially retroverted flow upon entering and leaving the expansion chamber. The muffler construction of the present invention is also arranged to direct the exhaust air flow from the muffler substantially away from the normal operator position with respect to the tool to eliminate line of sight between tool operating personnel and the exhaust openings from the muffler to atmosphere.

The present invention also contemplates a reduction in the noise level of a conventional pneumatic percussion tool by providing a muffler construction wherein an auxiliary exhaust flow stream from a percussion motor distributing valve interacts with the main exhaust flow stream to produce a synergistic effect in reducing the noise produced by exhaust air flow from the tool. Moreover, by controlling the rate of expansion of the exhaust air flow with the muffler according to the present invention the formation of ice due to moisture present in the exhaust air stream is largely prevented. The present invention further provides an exhaust air muffler for a pneumatic percussion tool which may be integrally formed as part of the tool casing and which occupies a minimum of space thereby not increasing materially the bulk of the tool.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal section view of a conventional pneumatic percussion rock drill embodying an exhaust air muffler in accordance with the present invention;

FIG. 2 is a transverse section view taken along the line 2—2 of FIG. 1;

FIG. 3 is a partial plan view of the rock drill and muffler of FIG. 1 including arrows indicating the exhaust air flow pattern within the shroud.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawing, a conventional pneumatic percussion rock drill is illustrated in partial longitudinal section and generally designated by the numeral 10. The drill 10 comprises a casing 12 having a cylinder bore 14 and a hammer piston 16 reciprocably disposed in said cylinder and forming therewith opposed expansible chambers 18 and 20. In a manner well known the hammer piston 16, in response to the alternate valving of compressed air to the opposed chambers 18 and 20, is operable to reciprocate rapidly to deliver percussive blows to a working implement, not shown. The cylinder 14 includes a relieved portion 22 in communication with ports 24 (see FIG. 3) which are directed substantially toward the forward end of the drill 10. As the hammer piston reciprocates in the cylinder 14, and alternately provides for communication of the chambers 18 and 20 with the relieved portion 22, the ports 24 are operable to exhaust motive air from said chambers.

The drill 10 also includes a motive air distributing valve 26 disposed adjacent one end of the cylinder 14. The distributing valve 26 is characterized by a sleevelike axially shiftable element 28 disposed in a valve chest 30. The valve 26 further includes a plug portion 32. The plug 32 coaxially surrounds a conventional rifle bar 34 which cooperates with a mechanism 36 to provide for rotation of the hammer piston 16.

The distributing valve 26, of a general type well known to those skilled in the art of percussion motors, is further characterized by the annular spaces 38, 40 and 42 which cooperate with the valve element 28 to provide for axial shifting of said element to alternately valve compressed air to the chambers 18 and 20 by way of suitable passages, not shown, in the casing 12 and including passage 44 in the plug 32. The distributing valve 26 in order to function properly is also required to exhaust quantities of motive air with the movement of the element 28. Exhaust air from the valve 26 is vented through passages 46 and 48 leading from space 42 and passage 50 in communication with annular space 52. The passage 46, 48 and 50 lead to an auxiliary exhaust port 54 on the exterior of the casing 12.

As discussed in U.S. Pat. No. 3,255,844 pulses of spent motive air exhausting from the chambers 18 and 20 produce objectionable noise over substantially the entire audible frequency range with the operation of a typical rock drill such as the drill 10. It has been determined that with a muffler in accordance with the present invention applied to a conventional rock drill a substantial amount of objectionable noise due to exhaust air can be eliminated without detracting from the performance or handling characteristics of the drill. According to the present invention a muffler shroud 56 is formed to fit the contour of the exterior of the casing 12 in spaced relationship thereto and to be sealingly disposed on the casing by means of a weld bead 58. The space between the shroud 56 and the casing 12 is divided into double expansion chambers 60 and 62 by means of a pair of baffles 64 which are disposed to form a venturilike orifice 66. The shroud 56 further includes a plurality of exhaust openings 68 arranged on opposite longitudinal sides of the shroud. The exhaust openings 68 are in communication with the expansion chamber 62 and are formed to direct the exhaust air into the atmosphere substantially forwardly or toward the end of the drill away from the normal drill operator work position which would be to the right of the drill 10, viewing FIG. 1 and FIG. 3.

As shown in FIG. 1 and FIG. 3 the shroud 56 is arranged on the casing 12 in a manner to provide for retroverted flow of exhaust air leaving the ports 24. As the sound pressure waves accompanying the air flow stream emanate from the ports 24, they strike a forward wall surface 70 of the shroud 56 and are reflected back against the successive waves from the casing exhaust ports. As indicated by the arrows in FIGS. 1 and 3, the exhaust air flows through the expansion chamber 60 into the expansion chamber 62. Due to the position of the baffles 64, which are arranged to direct the flow stream toward the wall surface 72, the exhaust flow stream again undergoes retroverted flow before leaving the muffler through the exhaust openings 68. It has been determined that higher frequency sound waves can be attenuated by a directional change in a source such as a moving airstream. Accordingly, the double retroverted flow path for the exhaust air provided by the muffler shroud 56 substantially attenuates the higher frequency noise normally associated with pneumatic percussion tools. The reflection of pressure waves off the forward and rear walls 70 and 72, respectively, of the shroud also contributes to attenuation of the noise produced by these waves as

a degree of pressure cancellation is achieved due to the interaction of the reflected waves and the waves moving toward the wall surfaces.

It has further been determined in the present invention that by providing the cross-sectional area of the orifice **66** to be in the range of three to four times the total area of the exhaust ports **24** and also providing for the total area of the exhaust openings **68** to be three to four times the area of orifice **66** that a suitable expansion of exhaust air from the drill **10** may be achieved without causing the well-known freezing of water vapor present in the exhaust air. Furthermore, the controlled expansion provided by the above area ratios largely eliminates the so-called jet noise associated with high-velocity streams of air without imposing a performance reducing back pressure on the drill **10**.

It has also been determined that by conducting the exhaust air flow from the distributing valve **26** into the expansion chamber **62** in a direction substantially opposing the exhaust flow from the expansion chamber **60** that a further noise reducing effect is obtained. It is believed that the pulsating flow from the distributing valve **26** produces sound pressure waves which interact with the sound waves from the main exhaust flow in such a way as to yield a reduction in the noise level of the drill which is greater than can be obtained by individually treating the two exhaust flow streams. The main drill exhaust flow and the distributing valve exhaust flow thereby produce a synergistic effect in reducing the exhaust noise of the drill **10**.

The muffler shroud **56** is also designed to not materially increase the volume envelope of the drill **10**. As may be noted from the drawing the shroud **56** does not extend above the normal profile of the backhead portion **74** nor does the shroud appreciably increase the transverse dimension of the drill as shown in FIG. **2**. The shroud **56** is preferably formed of cast steel or aluminum and, although an integral welded-on arrangement is preferred, suitable means could also be provided to make the shroud detachable from the casing.

What is claimed is:

1. In a pneumatic percussion tool:
a casing forming a cylinder;
a hammer piston reciprocably disposed in said cylinder and forming therewith expansible chamber means;
a motive air distributing valve having a shiftable valve element for valving quantities of motive air to said cylinder;
a muffler shroud disposed about the exterior of said casing in spaced relationship thereto;
means dividing said space between said muffler shroud and said casing into first and second expansion chambers, said means forming an orifice interconnecting said first and second expansion chambers;
exhaust port means opening from said cylinder into said first expansion chamber;
exhaust openings in said shroud communicating said second expansion chamber with the exterior of said muffler; and,
exhaust port means for said distributing valve opening into one of said expansion chambers for exhausting quantities of motive air directly into said one chamber in response to the shifting of said valve element.

2. The invention set forth in claim **1** wherein:
said distributing valve exhaust port means is arranged to direct exhaust air flowing therefrom into said second expansion chamber in a direction substantially opposing the flow of exhaust air from said cylinder passing through said orifice.

3. In a pneumatic percussion tool:
a casing forming a cylinder;
a hammer piston reciprocably disposed in said cylinder and forming therewith expansible chamber means;
a motive air distributing valve having a shiftable valve element for valving quantities of motive air to said cylinder;
a muffler shroud disposed about the exterior of said casing in spaced relationship thereto and forming expansion chamber means between said muffler shroud and said casing;
exhaust port means opening from said cylinder into said expansion chamber means;
exhaust openings in said shroud communicating said expansion chamber means with the exterior of said muffler; and,
exhaust port means for said distributing valve opening into said expansion chamber means for exhausting quantities of motive air directly into said expansion chamber means in response to the shifting of said valve element.

4. In a pneumatic percussion tool:
a casing forming a cylinder;
a hammer piston reciprocably disposed in said cylinder and forming therewith expansible chamber means;
a muffler shroud disposed about the exterior of said casing in spaced relationship thereto;
means dividing said space between said muffler shroud and said casing into first and second expansion chambers;
exhaust port means opening from said cylinder into one of said expansion chambers;
exhaust openings in said shroud communicating the other of said expansion chambers with the exterior of said muffler; and,
an orifice formed by said means dividing said space and interconnecting said first and second expansion chambers, said orifice having a flow area in the range of three to four times the total flow area of said exhaust port means opening from said cylinder.

5. The invention set forth in claim **4** wherein:
said exhaust openings in said shroud have a total flow area in the range of three to four times the flow area of said orifice.

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