

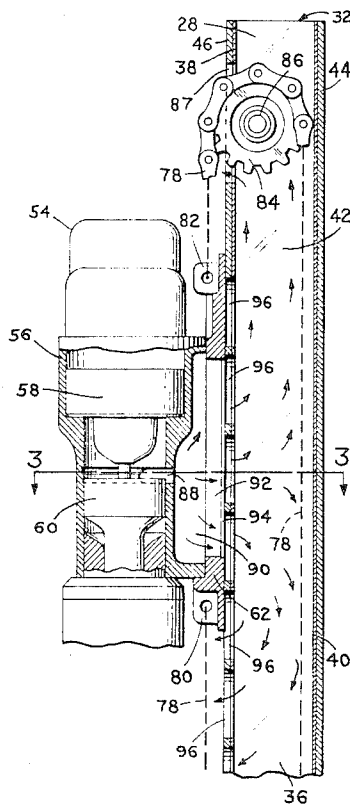
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 [21] Appl. No. **33,475**
 [22] Filed **Apr. 30, 1970**
 [45] Patented **Aug. 17, 1971**
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International Division of Worthington
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Holyoke, Mass.
 Continuation-in-part of application Ser. No.
 854,551, Sept. 2, 1969.

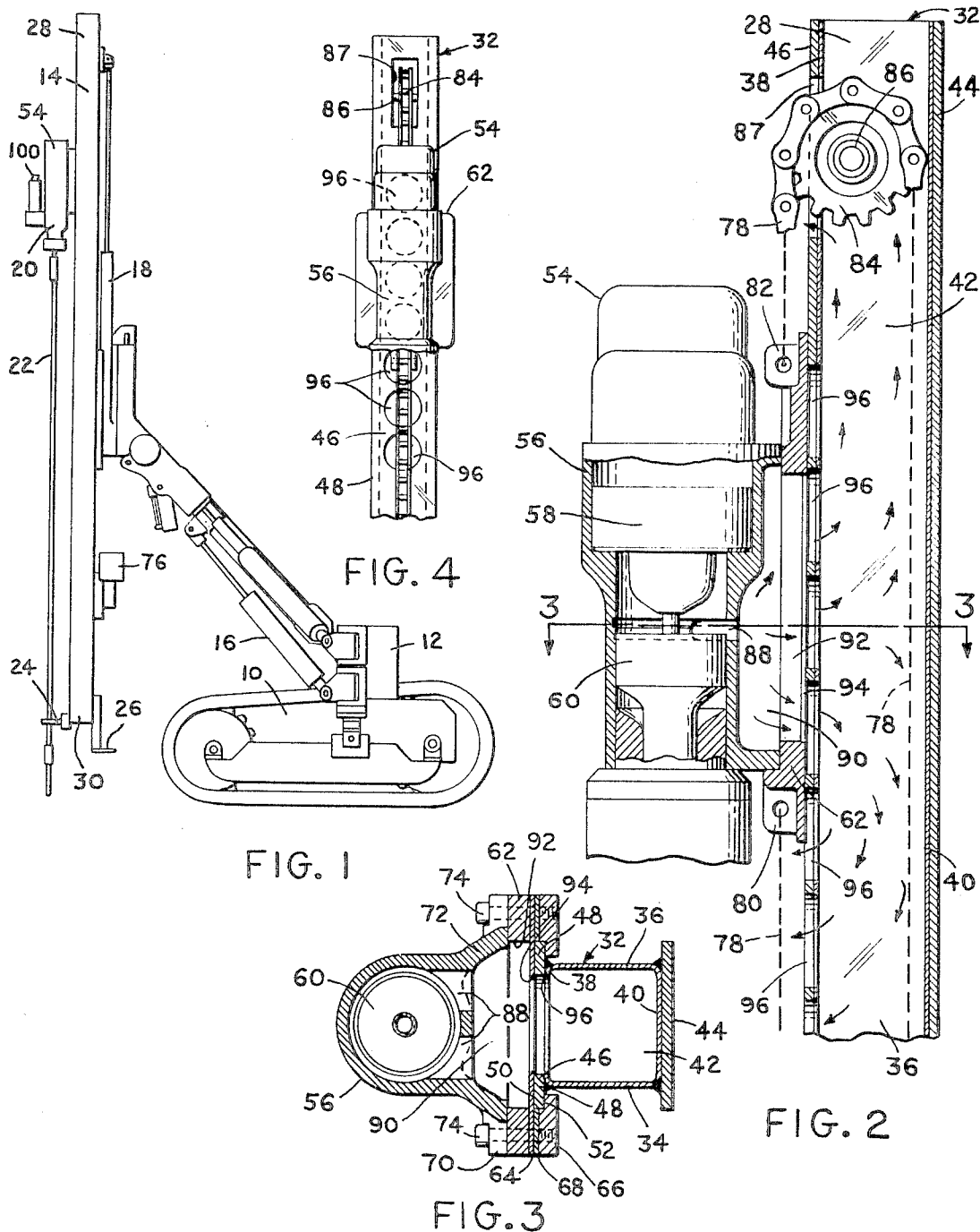
[56] **References Cited**
UNITED STATES PATENTS
 2,028,320 1/1936 Curtis..... 181/36 A
 3,385,395 5/1968 Kurt et al..... 181/36 A
 Primary Examiner—Robert S. Ward, Jr.
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[54] **ROCK DRILL FEED MAST WITH INTEGRAL**
MUFFLER AND OIL SEPARATOR
 8 Claims, 9 Drawing Figs.

[52] U.S. Cl..... **181/36 A,**
181/56, 181/60
 [51] Int. Cl..... **F01n 1/08,**
F01n 7/08, B25d 17/12
 [50] Field of Search..... **181/36 R,**
36 A, 56, 46, 60

ABSTRACT: A compressed air drill mounted and movable on a guide mast is presented wherein the guide mast is a boxlike structure having a plurality of openings to receive the exhaust from the drill. The guide mast forms part of a muffler and separator system wherein the drill exhaust is muffled and the oil is separated from the air to lubricate drill guides and a drive chain within the guide mast. A muffler element having two spaced plates is located in an expansion chamber between the exhaust ports on the drill and the guide mast. One of these plates is solid and acts as a baffle; the other of these plates is perforated and is placed adjacent to the openings in the guide mast whereby exhaust gases are deflected by the muffler structure and flow around the muffler structure and through the perforated plate.





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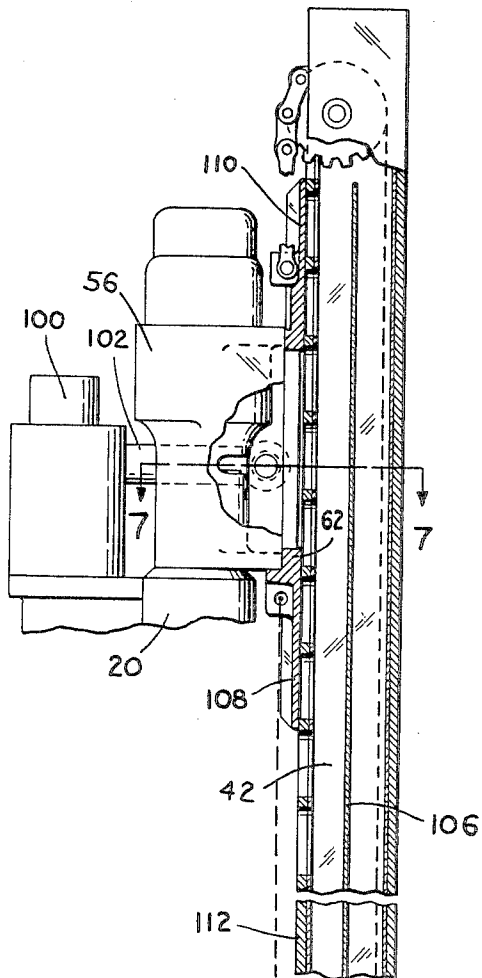


FIG. 5

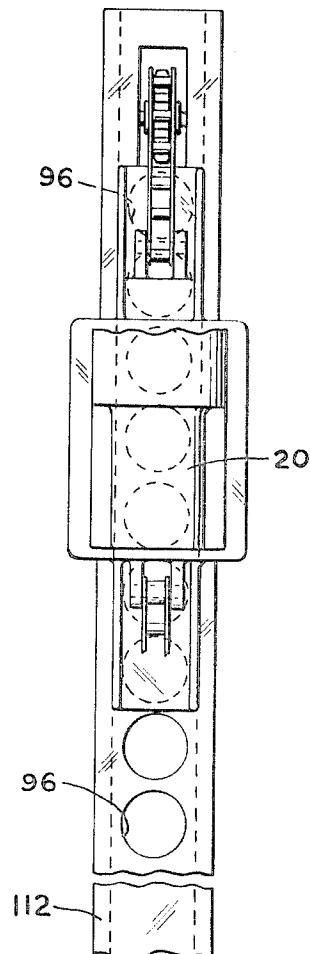


FIG. 6

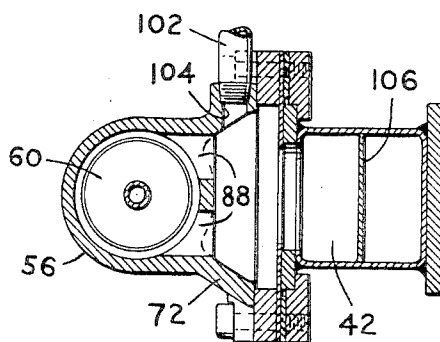


FIG. 7

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FIG. 8

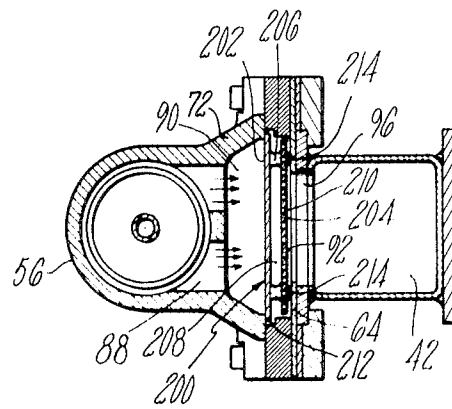
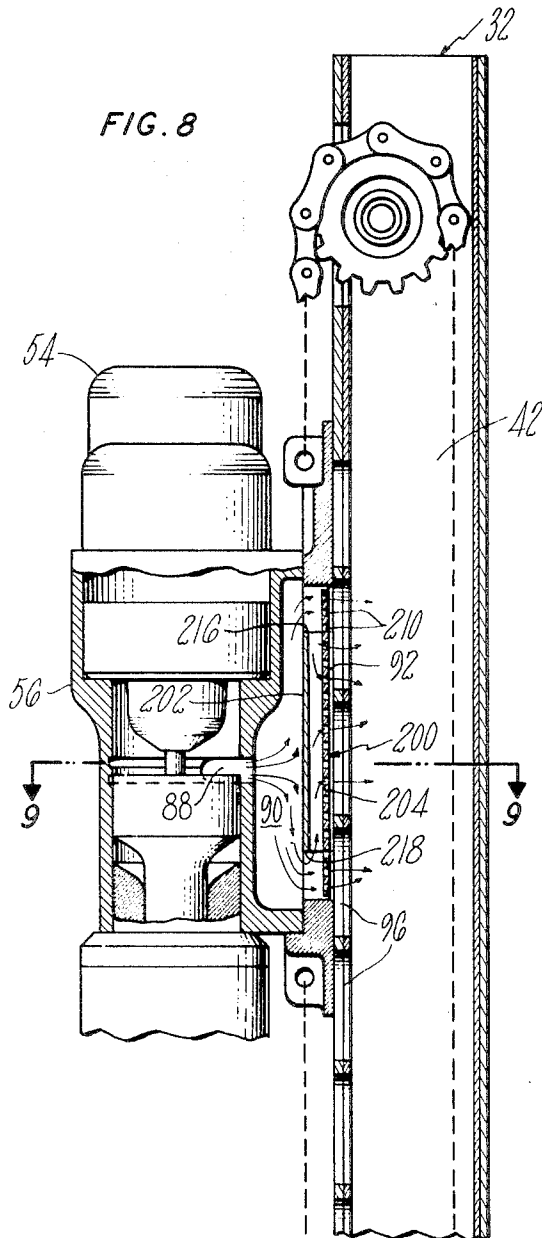


FIG. 9

ROCK DRILL FEED MAST WITH INTEGRAL MUFFLER AND OIL SEPARATOR

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of application Ser. No. 854,551 filed Sept. 2, 1969 and assigned to the assignee of the present case.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the field of pneumatic tools. More particularly, this invention relates to a system for both muffling the exhaust of pneumatic tools, especially drill-type tools movably mounted on a guide mast, and also for lubricating operating parts with oil separated from the exhaust.

2. Description of the Prior Art

The exhaust from compressed gas actuated devices has long been a source of problems. The noise produced by the exhausting gas causes great discomfort to personnel in the vicinity of the device. Additionally, the exhaust often contains oil or other liquids which are bothersome and often harmful when sprayed upon personnel in the vicinity of the compressed gas actuated device. These problems are particularly relevant to devices, such as pneumatic drills, which are mounted on and move along a guide structure during operation since it is often difficult to attach muffling means to such devices to reduce the noise level of the exhaust and to direct the exhaust in a controlled path to prevent undesirable indiscriminate spraying of the liquids in the exhaust.

Attempts have been made, especially with rock drills, to overcome these problems. An example of an early attempt to contain the exhaust from the compressed air actuated device is shown in U.S. Pat. No. 2,136,315 issued 1938 to Petit. A housing is used to enclose an entire rock drill assembly including the drill motor and the drill bit. The housing prevents exhaust from the drill motor from being randomly sprayed around the environment, and additionally the thick walls of the housing muffle not only the sound of the drill exhaust but also the noise of the impact produced by the drill tool striking the work surface.

A more recent attempt to deal with the exhaust problem from rock drills is shown in U.S. Pat. No. 3,385,395 issued May 1968 to E. H. Kurt et al. In this patent a rock drill device is mounted on a drill mast formed by two closed hollow sections. A long flexible hose is connected from the exhaust port of the drill to an inlet to the hollow sections to carry exhaust from the drill to the hollow sections. The exhaust then travels to the top of the hollow sections and is exhausted through a plenum chamber located at the top of the drill mast.

The construction of U.S. Pat. No. 3,385,395, however, can malfunction due to clogging of the long flexible hose connecting the exhaust port of the drill motor with the inlet in the hollow drill mast. The hose has to be long enough to allow for full travel of the drill along the drill mast; it adds weight to the drill; and it may introduce undesired back pressure on the drill. As the exhaust air leaves the exhaust port of the drill to enter the hose the air expands. The drop in temperature accompanying the expansion of the air often causes freezing of the moisture vapor in the exhaust as the exhaust travels through the hose, therefore clogging the hose.

These previous attempts at solving these problems have, however, for a variety of reasons, been ineffective or deficient.

SUMMARY OF THE INVENTION

To overcome the problems of the prior art this invention sets forth apparatus wherein a compressed gas actuated working tool is adapted to travel along guide means mounted on a boxlike walled support structure. A plurality of openings or orifices in an outer surface of the walled support structure are disposed in relation to the exhaust structure of the working tool so that the exhaust is directed through the openings as the

tool travels along the guide means. The exhaust enters an enclosure defined by the support structure where both the sound of the exhaust is muffled and entrained oil is separated from the exhaust to be used for lubricating purposes. Additionally, the positioning of the openings on the outer surface of the support structure can be used to provide for automatic control, such as starting and stopping, of the working tool as it travels along the guide means.

An expansion chamber is formed between the drill structure and the guide means whereby the exhaust gases immediately enter the expansion chamber upon leaving the drill structure prior to passing through the openings in the walled support structure. A double-plated muffler element is positioned in the expansion chamber immediately adjacent the walled structure. The plate closest to the support structure is perforated, and the other plate is solid. The exhaust gases from the drill impinge on the solid plate and are deflected around the ends thereof and then pass between the two plates and through the perforated plate into the openings of the support structure.

Accordingly, one object of the present invention is to provide a novel and improved pneumatic tool wherein the exhaust noise is reduced.

Another object of the present invention is to provide a novel and improved pneumatic tool wherein the exhaust is directed into an enclosure to prevent indiscriminate spraying of the exhaust to the surrounding environment.

Still another object of the present invention is to provide a novel and improved pneumatic tool wherein oil in the exhaust is separated as the exhaust is muffled and then used for lubrication.

Still another object of the present invention is to provide a novel and improved pneumatic tool wherein the exhaust from a working device is directed into the interior of the support structure on which the working device is mounted for travel to muffle the sound of the exhaust without requiring any flexible conduits connecting the working device to the interior of the support structure.

Still another object of the present invention is to provide a novel and improved pneumatic tool wherein the exhaust from a working device is directed into an expansion chamber having a muffler element therein and thence into the interior of support structure on which the working device is mounted.

Still another object of the present invention is to provide a novel and improved pneumatic tool wherein the exhaust from a working device is immediately directed into an expansion chamber wherein a double-plated muffler device is located, one of the plates being a solid baffle plate and the other plate being a perforated plate to allow passage of the exhaust gas.

Other objects and advantages will be apparent from the following description of several embodiments of the invention, and the novel features will be particularly pointed out hereinafter with the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings, wherein similar elements are numbered alike in the several figures:

FIG. 1 is a side elevation of a tractor mounted rock drill incorporating the features of the present invention.

FIG. 2 is a partial side view in partial section of the upper end of a rock drill and mast assembly built in accordance with the teachings of the invention.

FIG. 3 is a section along lines 3-3 of FIG. 2.

FIG. 4 is a partial front view of the rock drill and drill mast assembly shown in FIG. 2.

FIG. 5 is a partial side view in partial section of another embodiment of the rock drill and drill mast assembly incorporating the features of the invention.

FIG. 6 is a partial front view of the rock drill and drill mast assembly shown in FIG. 5.

FIG. 7 is a section along lines 7-7 of FIG. 5.

FIG. 8 is a view similar to FIG. 2 showing the modification incorporating the double-plated muffler.

FIG. 9 is a view similar to FIG. 3 taken along line 9-9 of FIG. 8.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 shows a compressed gas actuated assembly in the form of a rock drill system consisting of a crawler 10 with a frame 12 from which a drill mast 14 is supported by means of a plurality of hydraulic cylinders 16. As is standard in the art, the mast is positioned by means of the hydraulic cylinders 16 and a power cone cylinder 18. A pneumatic drill apparatus shown generally at 20 is mounted on drill mast 14. A drill rod 22 extends from the drill apparatus 20 past the bottom of the drill mast 14 and is positioned by a drill centralizer 24 protruding from the bottom of the drill mast 14. A foot support 26 extending from the bottom of the drill mast 14 is used to anchor the drill mast during operations of the drill. (The upper end 28 and the lower end 30 of drill mast 14 may, in accordance with the present invention, be either open or closed.) The hoses and other accessory equipment used to deliver compressed air to the drill are known in the art and are omitted here for purposes of simplicity.

As seen in FIGS. 2, 3 and 4, the drill mast is constructed from a box section member generally indicated at 32, having sidewalls 34 and 36, a front wall 38 and rear wall 40, all of which cooperate to define an enclosed elongated space or chamber designated generally at 42 which extends substantially the entire length of drill mast 14.

As seen particularly in FIG. 3, a rear stiffening plate 44 is welded to rear wall 40, and a front stiffening plate 46 is welded to rear wall 40, and a front stiffening plate 46 is welded to the front wall of the box section. The edges of front stiffening plate 46 protrude beyond the sidewalls 34 and 36 of the box section to form a pair of guides 48. Each guide has an upper surface 50 and a lower surface 52.

A drill motor generally identified at 54 is mounted on drill mast 14. The motor has a drill motor housing 56 which encloses a valve 58 used to control the flow of compressed gas to actuate the piston 60 which piston produces the impact action of the drill.

The drill housing is slidably mounted on the drill guides 48 by a multielement mounting means. A wear plate 64 and a clamping plate 66 are in slidable contact with the upper guide surfaces 50 and the lower guide surfaces 52 respectively of drill guides 48. A shim 68 is disposed between wear plate 64 and clamping plate 66 to space the wear plate from the clamping plate to prevent the plates from squeezing the drill guides and thereby inhibiting the sliding motion of these elements on the drill guides. The drill motor housing 56 is rigidly connected to a drill mount 62, sometimes referred to as a "slab-back," by means of bolting lugs 70 protruding from walls 72 which in turn extend from the drill motor housing 56. Fastening bolts 74 passing through the bolting lugs 20, the drill motor mount 62, the wear plate 64, the shims 68 and clamping plate 66 hold the elements of the mounting means in fixed relation to each other. It should be noted that walls 72 serve to define a plenum chamber for purposes to be more fully discussed hereinafter.

It should be pointed out, of course, that many other methods for slidably connecting the drill housing to the drill guides are available and could be used with equal effectiveness for the purposes of the present invention.

The drill motor housing is moved along the length of the drill mast 14 by means of a feed motor 76, shown in FIG. 1 which draws a chain 78 connected to the drill motor mount 62 at a forward chain attaching point 80 and a rear chain attaching point 82. The chain runs along the front of the drill mast 14 and then passes through a slot 87 near mast top 28 and into the interior chamber 42 of the drill mast as shown in FIG. 3. The chain then runs down the drill mast inside chamber 42 and emerges near the bottom of the mast. The chain drive mechanism is fairly conventional as shown by the upper half of the system in FIG. 2. The chain 78 runs over a

sprocket 84 mounted to the drill mast by means of an axle 86. A similar sprocket arrangement is provided at the bottom of the drill mast but is not shown for purposes of simplicity. The chain is fed to the advance motor through a slot in the back of the drill mast and a conventional chain guide system which have also not been shown for purposes of simplicity.

Exhaust Means for Drill Motor

Compressed gas used to actuate the drill by reciprocating the piston 60 leaves the drill motor housing 56 through exhaust ports 88 when, as shown schematically in FIG. 2, piston 60 is in a position which uncovers the exhaust ports. The compressed gas exhausted through exhaust ports 88 enters a plenum chamber 90 formed by walls 72 and passes through a drill mount passage 92 and wear plate passage 94 and finally passes into elongated chamber 42 through a plurality of drill guide exhaust openings or orifices 96 located in the front stiffening plate 46 and front wall 38 of the drill mast 14. The plenum chamber 90 and the passages in the wear plate 64 and drill mount 62 form a manifold which conducts the compressed gas leaving exhaust ports 88 into the drill guide exhaust orifices which are in turn in communication with chamber 42.

In traveling from exhaust 88 to plenum 90 and then to chamber 42, the exhaust gas passes through chambers or volumes of increasing size, and thus a distinct muffling or noise-reducing effect is obtained. After entering chamber 42 the exhaust gas expands and then flows, as indicated by the flow arrows, to the atmosphere through passages 96 which are open to atmosphere above the below drill mount 62. Since the drill is shown in FIG. 2 at the top of the mast, most of the exhaust flow is shown directed to passages below the drill; however, as the drill moves down the mast there are open passages 96 above and below the drill through which exhaust gas passes to atmosphere.

It can thus be seen that the elongated boxlike mast 14, by virtue of chamber 42, itself acts as a muffler chamber for the drill. At the same time the cross-sectional box shape of mast 14 imparts added strength and rigidity to the mast and improves the dimensional integrity of the mast, especially the width, thereby minimizing side play or wobble of the drill on the mast.

In addition to the muffling effect, the passage of the exhaust gas through the successively enlarged chambers 90 and 42 results in a separation of entrained oil from the air, and this separated oil then is deposited on the interior walls of chamber 42 and on the chain within chamber 42 thus lubricating and cleaning the chain. Some oil also tends to deposit on the drill guide structure to provide lubrication for those sliding parts. Lubrication may also come from direct impingement of oil-entrained gas on the chain.

Another Embodiment of the Invention

A second embodiment of the invention is set forth in FIGS. 5, 6 and 7. The drill motor 20 shown in FIG. 5 includes a rotation motor 100 connected to the drill motor housing 56. The rotation motor is a separate compressed gas actuated device used to provide torque to the drill rod. The compressed gas used to actuate the rotation motor is discharged from the rotating motor through an exhaust port (not shown) into a rotation motor exhaust tube 102 which is connected to a passage 104 through one of the plenum walls 72. The compressed gas entering plenum chamber 90 through passage 104 then mixes with the compressed gas exhausted from the drill motor housing exhaust ports 88 and passes into the drill guide enclosure 42 through the drill guide exhaust pathways 96 as previously described.

Sound-absorbing material 106 is disposed in the drill guide enclosure 42 to reduce the noise level produced by the exhaust from the drill motor and rotation motor as it enters the drill guide enclosure. Though shown disposed halfway between the front and rear walls of the drill mast, the sound-absorbing material could be disposed in many other convenient locations within the drill guide enclosure 42.

The drill motor mount 62 has an elongated front skirt 108 extending along the drill mast forward of the drill motor mount, and an elongated rear skirt 100 extending along the drill mast behind the drill motor mount. The purpose of these skirts is to block off drill guide exhaust openings immediately in front of and behind the drill motor mount thereby requiring the compressed gas which has passed into the drill guide enclosure 42 to travel a greater distance before exiting to the ambient atmosphere through the uncovered drill guide exhaust openings. By extending the distance the gas must travel through the drill guide enclosure, increased sound reduction is achieved.

As shown in FIGS. 5 and 6, a section of the front wall of the drill mast identified as 112 is solid and does not contain any of the drill guide exhaust openings 96. As the drill mount 62 travels along the drill guides it will reach a position on the drill mast where the drill motor mount passage 92 and wear plate passage 94 are no longer in communication with any of the drill guide exhaust openings 96. When the drill mount 62 is in this position the exhaust manifold consisting of the plenum chamber 90 and drill motor passage 92 and wear plate passage 94 coact with the solid section 112 to become a relatively airtight chamber. The pressure within the relatively airtight chamber will rapidly build up as the exhaust gas enters until the pressure in the airtight chamber is close to or equal to the pressure within the drill motor housing 56. When this condition occurs, no additional exhaust will flow from the exhaust port 88, or from the rotation motor exhaust tube 102, and the compressed gas actuated devices will thus automatically cease to operate. It will be understood that the structure and resulting automatic control effect of solid wall section 112 can be incorporated in the embodiment of FIGS. 1-4 described above or the embodiment of FIGS. 8 and 9 to be described below as well as in the embodiment of FIGS. 5-7.

Referring now to FIGS. 8 and 9, another modified embodiment is shown wherein a particular and unique muffler element 200 is located in plenum chamber 90. Muffler 200 is composed of a pair of plates 202 and 204 separated by a pair of spacers 206 whereby a chamber 208 is formed between the plates 202 and 204. Plate 204 occupies substantially the entire area of drill mount passage 92, and plate 204 is perforated over its entire surface with a large number of small diameter passages 210 on the order of about one-eighth of an inch in diameter. Plate 202 is spaced from plate 204 on the side closer to exhaust ports 88, and spacers 206 are welded between the plates 202 and 204 to form a fixed structure. As can be seen from an examination of FIGS. 8 and 9, the length of solid plate 202 is less than the length of perforated plate 204 (FIG. 8) but the width of solid plate 202 is greater than the width of perforated plate 204 (FIG. 9). This relative sizing of these parts allows for retention of the muffler in the drill structure while enabling these parts to perform their function of diverting and muffling the exhaust gases. Referring specifically to FIG. 9, the manner in which muffler 200 is retained in the drill structure is shown. The side edges 212 of plate 202 engage the ends of walls 72, and rubber spacer elements 214 are wedged between wear plates 64 and perforated plate 204. The rubber spacer elements 214 serve to force or wedge the ends of plate 202 against walls 72 thereby retaining the muffler structure in place.

Referring once again in both FIGS. 8 and 9, the exhaust gases from exhaust ports 88 enter into plenum chamber 90 as previously described. However, instead of passing directly through the passages 96 into chamber 42, the gases are first caused to encounter and come under the influence of muffler 200. The gases exiting from exhaust 88 strike plate 202, which is positioned in the line of flow of the gases from exhaust 88. Solid plate 202 acts as a baffle plate whereby the direction of flow of the exhaust gases impinging thereon is varied so that the gases turn and flow along plate 202. These turned exhaust gases then flow around top and bottom edges, 216 and 218, respectively, of plate 202 whereby the direction of the gases is again turned. The gases then flow both into chamber 208

between plates 202 and 204 and through the many perforations of plate 204 to then pass through openings 96 into chamber 42 for ultimate exhaust to atmosphere as previously described.

In addition to the direction of flow of the exhaust gases being turned twice by baffle plate 202, chamber 208 acts as a resonating chamber for the gas passing through that chamber, and the exhaust gases are caused to expand when passing through holes 210 as well as when first entering the expansion chamber and when passing through openings 96. Furthermore, in addition to causing turning of the gases, solid plate 202 also forces the gases to travel a longer path than would otherwise be the case if they were allowed to proceed directly to passages 96. The multiple turning of the direction of flow of the gases and the resonating chamber effect and the additional expansion through holes 210 when the gases come under the influence of muffler 200 all result in a substantial reduction in the velocity of the exhaust gases and a substantial reduction in the noise level of these gases. Accordingly, in addition to all of the features of the embodiments previously discussed, the embodiment of FIGS. 8 and 9 produces a further significant reduction in the noise level of the exhaust gases.

It will be understood that various changes in the details, materials and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention may be made by those skilled in the art within the principal scope of the invention as expressed in the appended claims.

While a preferred embodiment has been shown and described, various modifications and substitutions may be made without departing from the spirit and scope of this invention. Accordingly, it is to be understood that this invention has been described by way of illustration and not limitation.

What I claim is:

1. A compressed gas actuated device comprising:
 - a walled structure having an internal chamber;
 - a compressed gas actuated tool mounted on said walled structure for travel along said walled structure;
 - exhaust chamber means on said tool communicating with an exhaust port on said tool for exhausting working gas from said tool;
 - muffler means in said exhaust chamber means; and
 - a plurality of orifices through said walled structure, said exhaust chamber means communicating with said internal chamber through at least one of said orifices to exhaust the working gas into said internal chamber.
2. A compressed gas actuated device as in claim 1 wherein said muffler means includes:
 - a first plate facing the exhaust port on said tool;
 - a second plate spaced from said first plate on the side removed from said exhaust port;
 - said second plate having a plurality of openings therethrough.
3. A compressed gas actuated device as in claim 2 wherein:
 - said first plate is of a size less than the cross-sectional size of said exhaust chamber at the location of said second plate.
4. A compressed gas actuated device as in claim 3 wherein:
 - said first plate forms a baffle plate;
 - said first and second plates define a chamber therebetween; and
 - said second plate has openings therethrough distributed substantially uniformly spaced over the entire plate.
5. A compressed gas actuated device as in claim 4 wherein:
 - each of said first and second plates has a length and a width dimension, at least one of said dimensions of said second plate being greater than the corresponding dimension of said first plate.
6. A compressed gas actuated device as in claim 3 wherein:
 - said openings in said second plate communicate with said orifices in said walled structure, each of said openings in said second plate being smaller than one of said orifices in said walled structure.
7. A compressed gas actuated device as in claim 6 wherein:

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said exhaust chamber means is of smaller volume than said internal chamber.
8. A compressed gas actuated device as in claim 7 wherein: said exhaust chamber means includes walls protruding from

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said tool; and further including:
retaining means urging said muffler means against the ends of said walls to retain said muffler means in position.

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