United States Patent

[11] 3,547,222

[72] Inventor **Linwood A. Pickle**
South Hadley, Mass.

[21] Appl. No. **854,551**
[22] Filed **Sept. 2, 1969**
[45] Patented **Dec. 15, 1970**

[73] Assignee **Worthington Corporation**
Harrison, N.J.
a corporation of Delaware

[54] **ROCK DRILL FEED MAST WITH INTEGRAL MUFFLER AND OIL SEPARATOR**
12 Claims, 7 Drawing Figs.

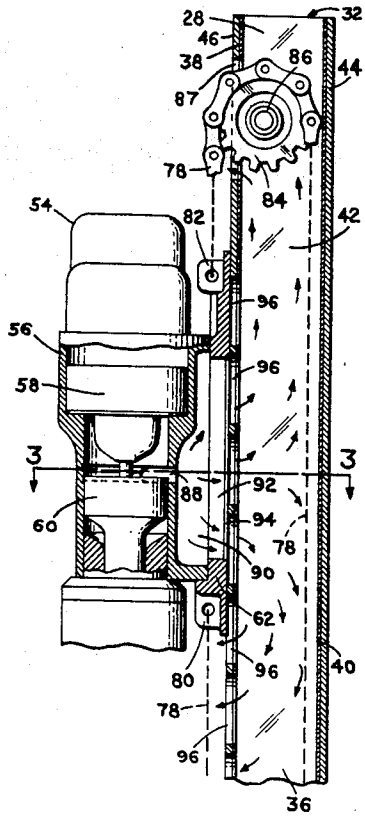
[52] **U.S. Cl.** **181/36,** 181/56, 181/57, 181/60
[51] **Int. Cl.** **E21c 11/00,** F01n 1/08
[50] **Field of Search** 181/36, 36.1, 47, 57, 60, 56

[56] **References Cited**
UNITED STATES PATENTS

2,028,320	1/1936	Curtis	181/36(.1)
3,385,395	5/1968	Kurt et al.	181/36(.1)

Primary Examiner—Robert S. Ward Jr.
Attorney—Fishman & Van Kirk

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.



PATENTED DEC 15 1970

3,547,222

SHEET 1 OF 2

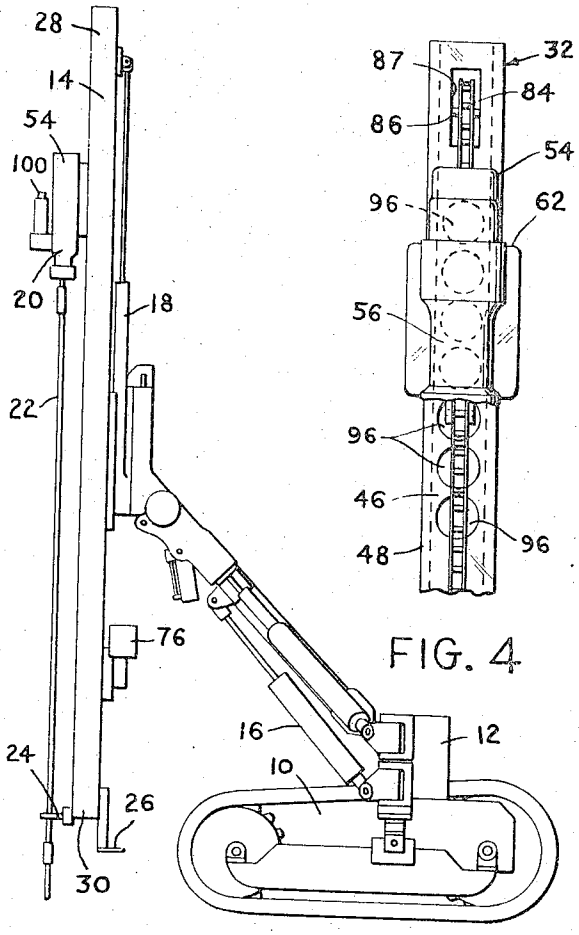


FIG. 1

FIG. 4

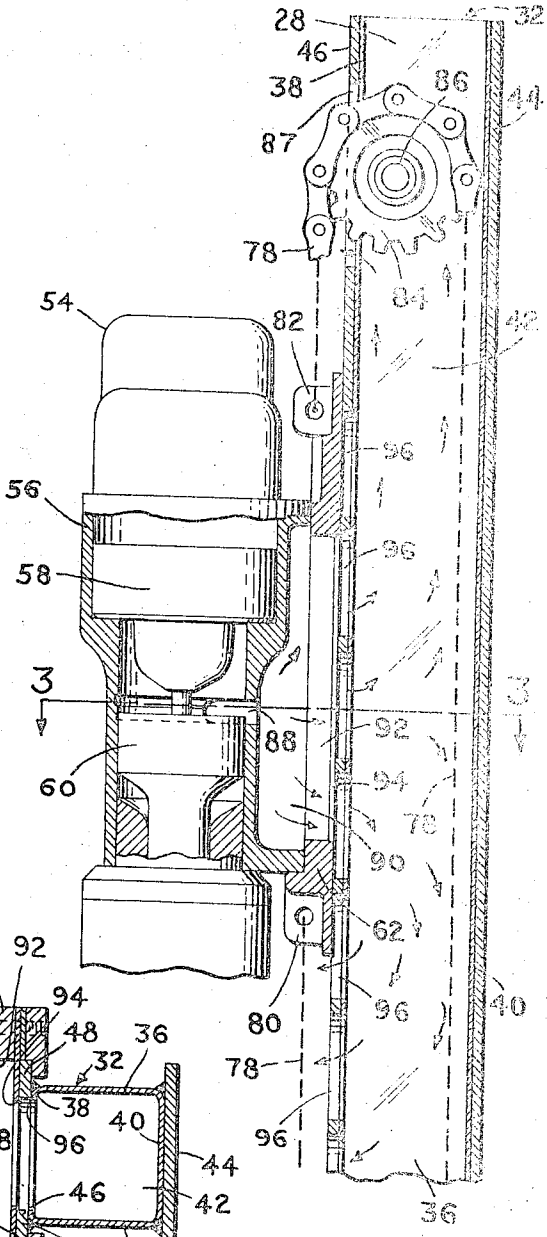


FIG. 2

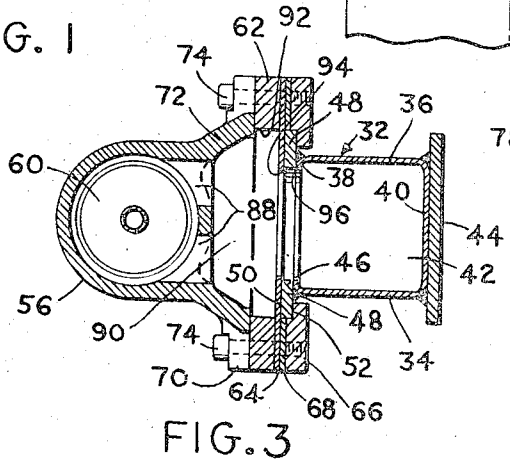


FIG. 3

LINWOOD A. PICKLE
INVENTOR.
BY Fishman and Van Kirk
Attys

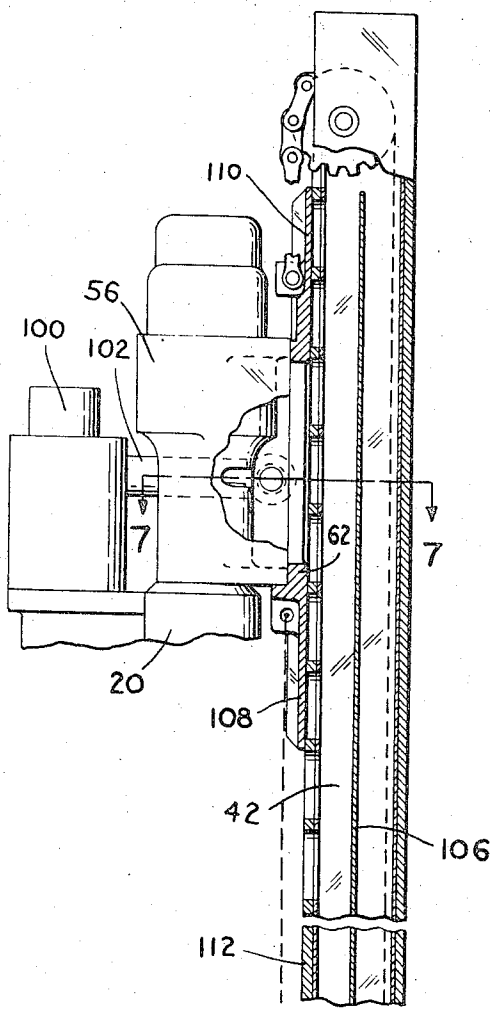


FIG. 5

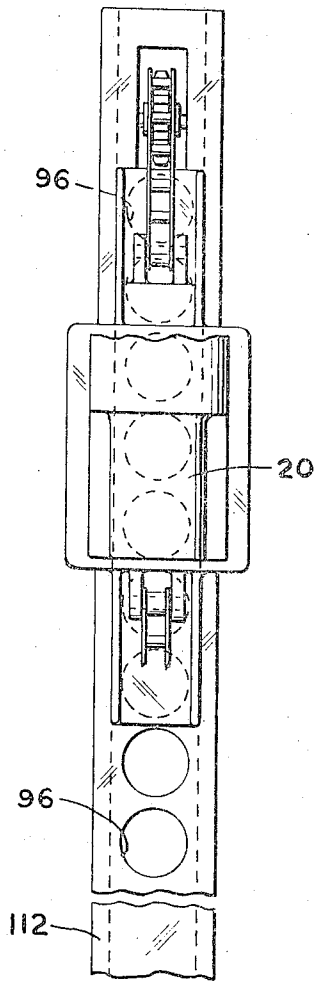


FIG. 6

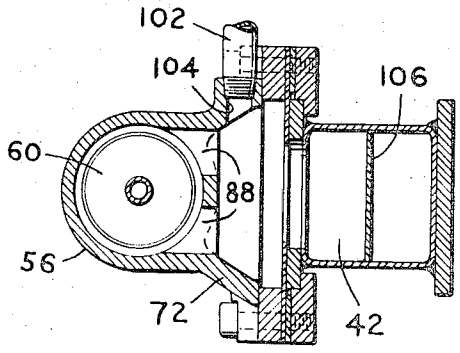


FIG. 7

LINWOOD A. PICKLE
INVENTOR.
BY Fishman and Van Kirk
Attys

ROCK DRILL FEED MAST WITH INTEGRAL MUFFLER AND OIL SEPARATOR

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.

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 a working device travels along a walled support structure and coacts with the walled support structure to automatically control operation of the working device.

Still another object of the present invention is to provide a novel and improved pneumatic tool having a working device which travels along a walled support structure and whose discharge structure coacts with the walled support structure to vary the pressure to which the exhaust gas is discharged from the working device thereby controlling the operation of said working device.

Still another object of the present invention is to provide a novel and improved pneumatic tool having a walled support structure of high strength and stiffness, which support structure additionally acts to receive and muffle exhaust from the pneumatic tool.

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 FIGS.:

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.

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 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 and 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 rotation 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 as well as in the embodiment of FIGS. 5— 7.

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.

I claim:

1. A compressed gas-actuated device comprising:
a walled structure having an internal muffling chamber;
guide means mounted on an outer surface of said walled structure;
a compressed gas-actuated tool mounted on said guide means for travel along the guide means;
exhaust chamber means on said tool for exhausting working gas from said tool; and
a plurality of orifices through said walled structure, said exhaust chamber means communicating directly with said internal muffling 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 at least two of said orifices are in communication within said walled structure, at least one of said two orifices being open to atmosphere.

3. A compressed gas-actuated device as in claim 1 wherein said exhaust chamber means includes:
an exhaust port on said compressed gas-actuated tool;
an intermediate chamber between said tool and said walled structure, said intermediate chamber being of smaller volume than said internal muffling chamber; and wherein
said intermediate chamber is in communication with said internal chamber through a first plurality of said orifices and said internal muffling chamber is in communication with the atmosphere through a second plurality of said orifices.

4. A compressed gas-actuated device as in claim 1 wherein said exhaust chamber means comprise:
an exhaust port on said compressed gas-actuated tool; and
manifold means connected to said compressed gas-actuated tool, said manifold means being in communication with said exhaust port and communicating with at least one of said orifices to direct the exhausted working gas to said internal muffling chamber of said walled structure.

5. A compressed gas-actuated device as in claim 4 wherein said manifold means is of smaller volume than said internal muffling chamber of said walled structure.

6. A compressed gas-actuated device as in claim 5 wherein said manifold means comprise:
walls protruding from said compressed gas-actuated tool;
mounting means slidably coacting with said guide means;
connecting means rigidly connecting said walls to said mounting means to form a plenum chamber between said walls and said compressed gas-actuated tool and said mounting means; and
passage means in said mounting means communicating said plenum chamber with said orifices in said outer surface of said walled structure.

7. A compressed gas-actuated device as in claim 6 wherein:
said guide means comprise a pair of guide surfaces extending from the outer surface of said walled structure; and said mounting means comprise:
a wear plate in sliding engagement with said guide surfaces;
a drill mount resting on the side of said wear plate remote from said guide surfaces;
clamping plate means adapted to coact with said drill mount to clamp said mounting means to said guide means in sliding relation thereto; and
bolt means coacting with said compressed gas-actuated tool, mounting plate, wear plate, and clamping means to slidably fasten said compressed gas-actuated tool to said guide means.

8. A compressed gas-actuated device as in claim 1 further including drive means to move said compressed gas-actuated tool along said guide means, said drive means comprising:
chain means connected to said compressed gas-actuated tool;
means connected to said walled structure to draw on said chain; and
at least a portion of said chain passing through said walled structure and extending along said internal muffling chamber of said walled structure whereby oil entrained in said working gas exhausted into said internal muffling chamber will impinge on said portion of said chain.

9. A compressed gas-actuated device as in claim 1 further comprising sound dampening means disposed in said internal muffling chamber to reduce the noise produced by the working gas exhausted into said internal chamber.

10. A compressed gas-actuated device as in claim 6 wherein said compressed gas-actuated tool comprises:
a first motor housing having a first compressed gas exhaust port;
a second motor housing coupled to said first motor housing having a second compressed gas exhaust port;
said walls extending from said first motor housing to form a plenum chamber for the exhaust from said first compressed gas exhaust port; and further comprising:
passage means through said plenum walls; and
conduit means connecting said second compressed gas discharge port with said passage in said plenum walls to carry compressed gas exhausted from the second motor housing to said plenum chamber.

11. A compressed gas-actuated device as in claim 1 wherein: said exhaust chamber means include a manifold in communication with the outer surface of said walled structure; and wherein a portion of said one surface of said walled structure is closed to the passage of exhaust gas, said manifold coacting with said closed portion of said one surface to form a relatively airtight chamber preventing continued exhaust from said compressed gas-actuated device.

12. The combination claimed in claim 6 wherein said mounting means further comprise at least one skirt member extending along said guide means to cover orifices through said walled structure as said compressed gas-actuated tool moves along said guide means.