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EXHAUST PIPE ASSEMBLY FOR PNEUMATIC TOOLS

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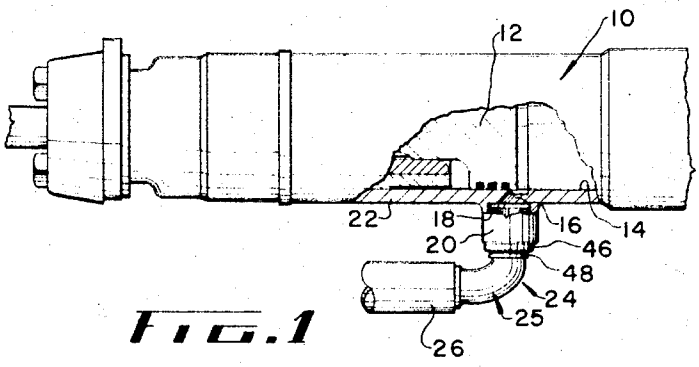

FIG. 1

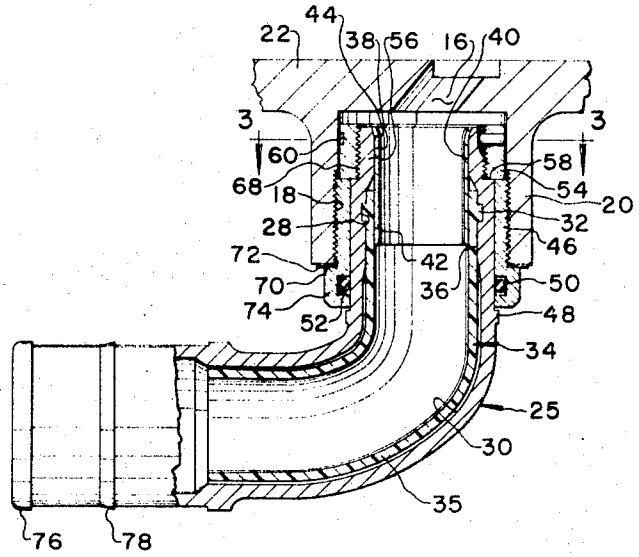

FIG. 2

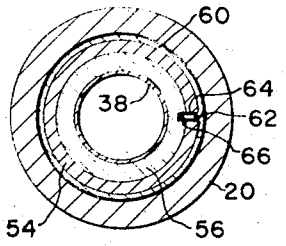

FIG. 3

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EXHAUST PIPE ASSEMBLY FOR PNEUMATIC TOOLS

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ABSTRACT OF THE DISCLOSURE

An exhaust pipe assembly for pneumatic tools, particularly applicable to percsussion type tools, consisting of a swivelly mounted curved tubular conduit in combination with a flexible inner sleeve fixed at one end relative to the outer surrounding conduit. The inner sleeve is of a flexible material such as neoprene and is subject to flexing and vibrating movement in response to the kinetic energy transmitted to it from the exhaust fluid pulsations emitting from the tool working chamber. The flexing inner sleeve serves to break up and prevent the lodging of ice in the tool exhaust system and also serves as a simple yet effective muffler of the exhaust noise generated by the tool working fluid.

Background of the invention

The application of pneumatic rock drills and similar pneumatic expansion devices in underground operations such as tunneling and mining work usually produces a considerable amount of fog in the vicinity of the work area due to rapid expansion and cooling of the compressed air used to power the tools. The climatic conditions usually present in mines and tunnels are quite conducive to this fog formation and in addition the exhausting of the compressed air from the tools produces a noise level in the area often uncomfortable if not intolerable to personnel. As a result it is common practice to conduct the exhaust from pneumatic rock drills and associated equipment to locations remote from the immediate work area by means of flexible hoses or the like attached directly to the exhaust ports of the tools. In this way fog, objectional fumes, and high noise levels near the tools are avoided. However, a condition which is often unavoidable near the exhaust ports of rock drills and the like, particularly when the exhaust is conducted through a closed conduit, is the formation and accumulation of ice immediately downstream of the exhaust port and in the exhaust pipe or hose, again, due to a well understood cooling phenomena which also produces the aforementioned fog. This ice accumulation is often substantial to the extent that the tool becomes inoperative after a short period of time due to blockage of the exhaust system. This ice accumulation usually occurs where directional change of some magnitude is given to the exhaust flow so that the small ice particles present in the fluid stream impinge and accumulate over a relatively small area.

The invention disclosed herein is somewhat analogous in purpose to the known prior art in the patents to Fuehrer 2,128,742, Morrison 2,166,218, and Jordan 3,164,962 each of which has a vibrating element fixed to a casing surrounding the tool proper and constituting an integral part of the tool body. It is, however, apparent that the prior art fails to disclose an external tool attachment that may be positioned within the exhaust flow path

of a conventional tool and provided with vibrating means agitated by tool exhaust for the purpose of preventing accumulation of ice crystals in the exhaust flow path.

Summary of the invention

The invention disclosed brings solutions to the problems of prohibiting ice formation and accumulation as well as contributing to the attenuation of noise in the exhaust system of pneumatic power tools by providing an exhaust control means having a flexible sleeve of a suitable material held in spaced relation to an outer conduit and fixed at one end relative thereto. The conduit means is curved to assure impinging flow of the exhaust fluid on the flexible sleeve which results in the flexing and vibrating of the sleeve to prevent the accumulation of ice and to absorb a substantial amount of the pressure wave energy usually manifested as audible sound.

An object of the invention is the provision of a smooth surfaced, surroundingly disposed, flexible conducting means for the exhaust flow, wherein possible locations for the lodging of ice particles are eliminated by a simple yet effective structure of great reliability.

It is also an object of the invention to provide an exhaust control apparatus that can have secured to its free end a flexible hose of any desired length through which the final exhaust composed of broken ice particles or water and objectionable fumes may be conducted to a point remote from the operator. To facilitate handling of the tool with the exhaust hose attached, the manifold is swivelly mounted on the tool for ease in handling and positioning.

Brief description of the drawing

FIG. 1 is a front elevation, partly in section, of a conventional percussion tool having associated therewith the elements of the invention.

FIG. 2 is an enlarged sectional view showing a part of the tool cylinder and its exhaust passage having attached thereto the exhaust pipe assembly and the elements swivelly connecting the two.

FIG. 3 is an end view of the pipe assembly taken along the line 3—3 of FIG. 2 illustrating the locking means for preventing movement of the locking nut on the pipe assembly when the latter is swung relative to the tool casing.

Description of the preferred embodiments

Referring to the accompanying drawing in detail, particularly FIG. 1, a conventional pneumatic percussion tool, generally designated by the numeral **10**, has an expansible chamber defined by a reciprocating piston **12** and a cylinder **14**. An exhaust port **16** communicates the cylinder **14** with the partially threaded bore **18** of a boss **20** disposed on the side of the tool casing **22**. Positioned within the bore **18** is one end of an exhaust pipe assembly **24** having therein an element vibrated by the exhaust fluid pulsations passing therethrough. The pipe assembly **24** comprises a bent or curved tubular member **25** having connected to its free end, by any suitable means, a flexible hose **26** through which the exhaust flow may be conducted to a suitable point usually remote from the tool and the operating personnel.

FIG. 2 illustrates in detail the elements comprising the exhaust pipe assembly **24** including those elements used for swivelly connecting the pipe assembly to the boss **20** on the tool casing **22**. In the pipe assembly illustrated, the outer tubular member **25** is preferably constructed of

a piece of steel tubing machined to provide the grooves, relieved section, and flanges to be explained later in detail. A preferred method of obtaining the desired bent shape of the tubular member **25** is to cut one or more V-shaped notches all in the same longitudinal plane after the machining process. The tubular member **25** is then heated and bent until the edges of the V-shaped notches abut each other wherein they are joined by welding or an equivalent process.

Near the upper end of the tubular member **25** is an internal annular groove **28** which interfittingly receives an external flange **32** formed as an integral part of a flexible curved inner sleeve **34**. Adjacent to the flange **32** the flexible sleeve **34** fits snugly in the bore **36** of the tubular member **25**. The remaining major portion **35** of the flexible sleeve **34** is thereby held in fixed spaced relation to the internally relieved major portion **30** of the tubular member **25**. To assist in maintaining the flexible sleeve **34** in fixed relation with the tubular member **25** a short metal tube **38** is pressed into a reduced bore portion **40** at the extreme upper end of the tubular member **25**, as viewed in FIG. 2; and, the tube **38** compressively engages the inner wall **42** of the flexible sleeve **34**. The upper end of the metal tube **38** is flared to fit tightly within the beveled end **44** of the tubular member **25**. Albeit many materials are well known that would be suitable for the construction of the flexible sleeve **34**, a particularly suitable sleeve is obtained when molded of one of the chloroprene elastomers, such as neoprene, which has resiliency, can be molded with a high degree of surface smoothness, and is relatively impervious to chemical substances.

For swivelly mounting the exhaust pipe assembly **24** on the pneumatic tool **10** the tubular member **25** is journaled in an externally threaded collar **46**.

The threaded collar **46** is secured to the boss **20** by being screwed into the partially threaded bore **18** until a flange **74** on the collar **46** is tight against the face **70** of the boss **20**. A gasket **72** is interposed between the flange **74** and the face **70** to prevent leakage of exhaust fluid therearound. A seal is also affected around the bore of the collar **46** by an O-ring **50** in a groove **52** sealingly engaging the outer diameter of tubular member **25**. Limited axial movement of the tubular member **25** in its journaled relationship with the collar **46** is maintained by a locking nut **54** threaded over a reduced diameter portion **56** at the upper end of the tubular member **25**, and by an external annular flange **48** projecting from the outer diameter of the tubular member **25** below the flange **74** on the collar **46**. With the locking nut **54** screwed tightly against the shoulder **58** on the tubular member **25** sufficient axial play of the tubular member **25** relative to the collar **46** is maintained to allow the tubular member **25** to swivel freely.

The locking nut **54** is secured to the tubular member **25**, for the prevention of unscrewing of the nut from the tubular member **25**, by a retaining ring **60** shaped to be biased to seat in a groove on the locking nut **54**. Referring to FIG. 3, the retaining ring **60** has one end bent to form a tab **62** which projects through a slot **64** in the locking nut **54** and into a slot **66** in the reduced diameter portion **56** of the tubular member **25**. Should the slot **64** in the locking nut **54** not be in radial registration with the slot **66** in the reduced diameter portion **56** when the locking nut **54** is threaded down tight against the shoulder **58**, the nut may be unscrewed until said radial registration occurs with the resulting increased axial play allowed the tubular member **25** relative to the collar **46** not being detrimental to the performance of the swivel assembly since the amount of axial play will not exceed one pitch of the threads **68**.

In operation it will be apparent that the flexible sleeve **34** is so disposed relative to the exhaust port **16**, and is curved to such proportions as to be impinged by and to deflect the exhaust fluid stream substantially. This impinging action of the exhaust stream with its attendant pressure waves caused by incomplete expansion of the working fluid in the tool proper imparts sufficient energy to the flexible sleeve **34** to cause it to flex and vibrate sufficiently that those ice particles present in the exhaust flow are prevented from accumulating in the exhaust pipe and thereby preventing unwanted restriction in the exhaust system of the tool. The smooth curved shape of the flexible sleeve **34** and the absence of any sharp corners or shapes that could permit the lodging of solid particles also contribute to the prevention of ice particle accumulation. Although a curved or bent configuration assures impinging flow of the exhaust stream and more efficient operation of the exhaust pipe assembly, a straight sleeve would absorb exhaust flow pulsations to an extent that substantial flexing of the sleeve would still occur. In the illustrated embodiment it will be noted that the curved portion of the pipe assembly is not a circular arc. Experimentation has determined that a basically elliptical shaped curvature is more effective in preventing ice accumulation and it is believed that this curvature allows more direct impingement by a greater portion of the exhaust flow and thereby transfers more energy of impact to the flexible sleeve. Singularly significant is the use of the chloroprene elastomer material for the flexible sleeve **34** which has such smooth surface character that it also aids in the prevention of ice accumulation.

Of no less importance is the fact that the unsteady and variable amplitude vibration of the flexible sleeve **34** also serves to impart a degree of cancellation of the pressure waves present in the exhaust flow which manifest themselves in the form of audible sound. In addition sound attenuation capability of the manifold assembly is enhanced by the layer of air insulation formed between the major portion **35** of the flexible sleeve **34** and the relieved portion **30** of the tubular member **25**.

As previously mentioned, a section of flexible hose **26** (FIG. 1) may be attached to the downstream end of the tubular member **25** by being snugly positioned over the raised portions **76** and **78** and held suitably secure by the same in a manner well known. The exhaust flow can then be conducted any desired distance from the operator and given directional attitude sufficient to obviate any further need for treatment to reduce noise.

Having shown that the invention has particular novelty and utility, it will be appreciated that application to the tool **10** would not be a limitation in its use but that a number of expansible chamber devices utilizing compressed air and subject to the problems herein solved could enjoy the benefits of the invention.

What is claimed is:

1. (a) An expansible chamber tool operable by compressed air and having an exhaust port for conducting expanded exhaust air from said chamber, said expanded exhaust air containing ice particles formed therein as an incident to expansion;

(b) an exhaust pipe assembly having one end connectable with said exhaust port for receiving said exhaust air and ice particles therefrom; said exhaust pipe assembly comprising;

(1) tubular conduit means in communication with said exhaust port;

(2) flexible tubular sleeve means having a major portion disposed within said conduit means for flexing in response to exhaust fluid flow therethrough whereby such flexing prevents the accumulation of said ice particles in said exhaust pipe assembly, said flexible sleeve is secured adjacent said end of said exhaust pipe assembly which is connectable with said exhaust port, and the remainder of said sleeve being generally of like configuration with respect to said conduit is disposed in spaced relation therein, and

(3) said exhaust pipe assembly is curved sufficiently for expanded exhaust air flowing therethrough to impinge on said sleeve to flex the same.

2. The invention set forth in claim 1 wherein:
said flexible sleeve comprises a smooth surfaced hollow body molded of a chloroprene elastomer.

References Cited

UNITED STATES PATENTS

331,806	12/1885	McGahan	285—278
1,927,105	9/1933	Welch	138—28
1,964,123	6/1934	Kaiser	138—148
2,166,218	7/1939	Morrison	60—64
2,670,717	3/1954	Armington	92—119
2,801,133	7/1957	Ridley	138—147 X
2,982,311	5/1961	Haskell	138—148 X
3,099,993	8/1963	Smith	138—148 X
3,133,612	5/1964	Sailler	138—148 X
3,187,936	6/1965	Downing	138—114 X

FOREIGN PATENTS

10,030	3/1898	Great Britain.

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U.S. Cl. X.R.

92—119; 138—148