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Thrasher

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[54] **SILENCER AND LUBRICANT TRAP FOR AIR TOOL EXHAUST**

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[52] **U.S. Cl.** ..... **181/36 R,** 55/276, 55/337, 181/36 A

[51] **Int. Cl.** **F01n 3/06**

[58] **Field of Search** ..... 55/276, 337, 413, 414, 55/449, 456; 181/36 R, 36 A, 36 C, 57, 58, 60, 63, 66, 67

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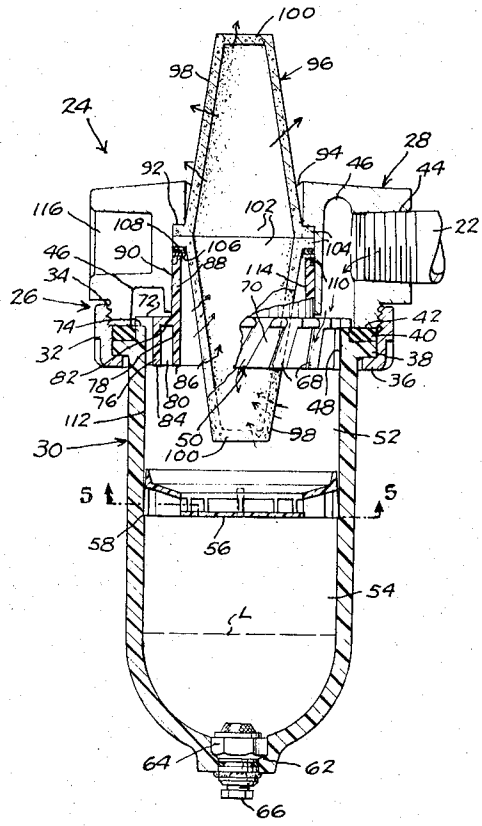
[57] **ABSTRACT**

A combined baffle and air turbulator-lubricant interceptor gap is mounted within the upper part of a cup defining an expansion chamber and subjacent lubricant sump. The baffle directs exhaust air from a pneumatic tool into circumferential, lubricant-depositing impingement against the wall of the expansion chamber. The turbulator-interceptor gap prevents lubricant from being propelled along interior surfaces to the outlet. Engaged-base double cones of porous sintered metal in the outlet muffle the sound of the outgoing air by breaking up its flow into myriad paths.

16 Claims, 5 Drawing Figures



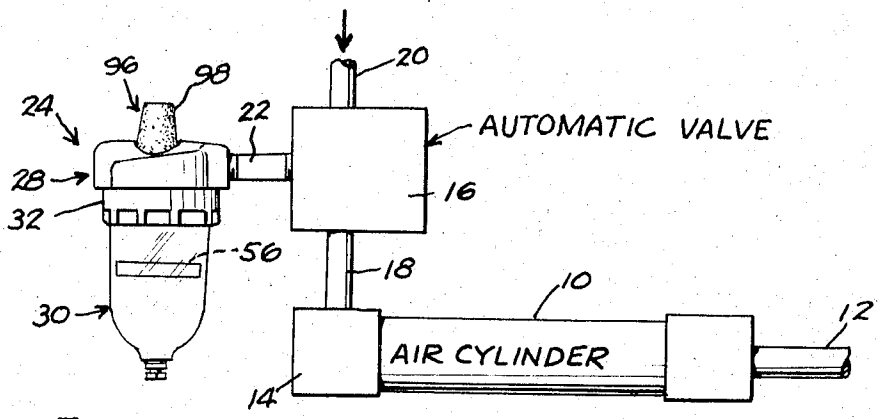


FIG. 1

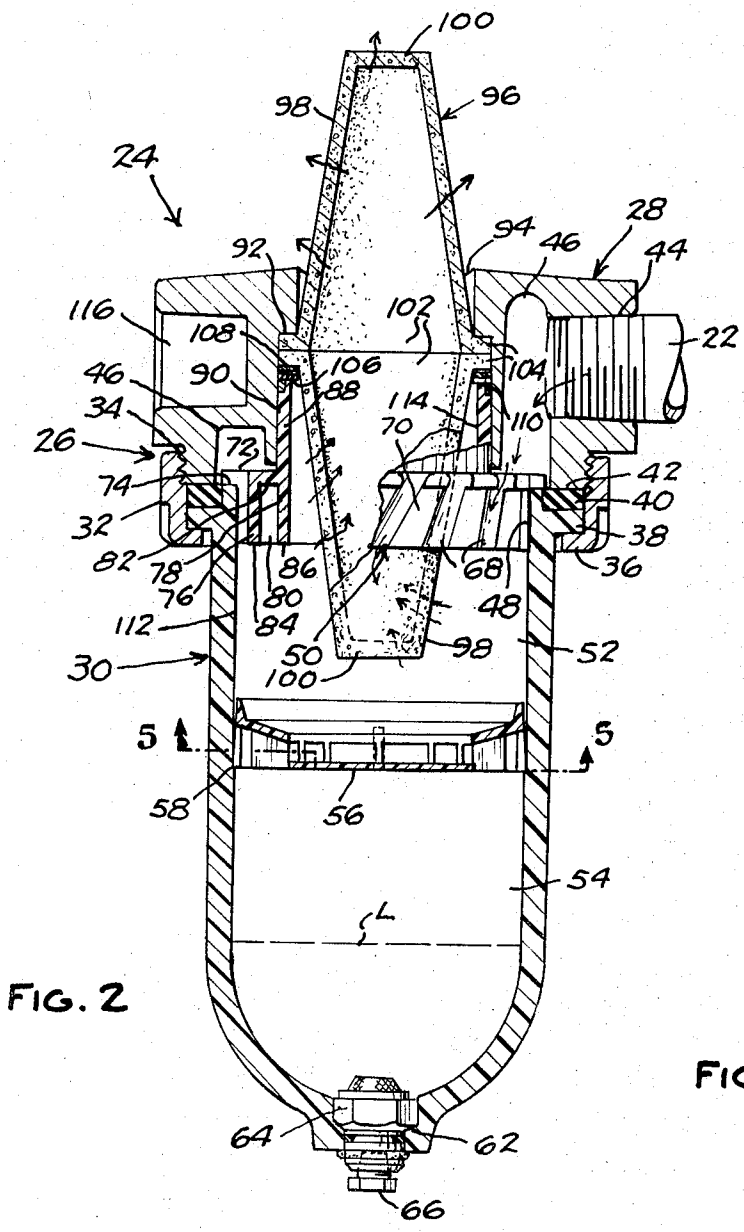


FIG. 2

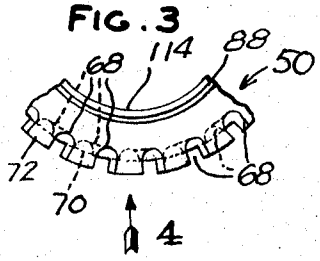


FIG. 3

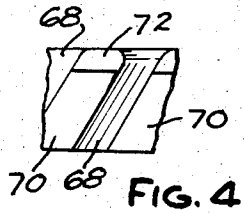


FIG. 4

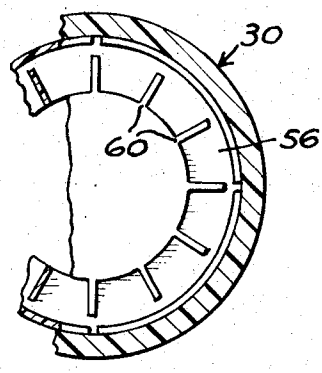


FIG. 5

SILENCER AND LUBRICANT TRAP FOR AIR TOOL EXHAUST

This invention relates to a device for removing lubricant from air exhausting from a pneumatic motor and for muffling the sound of the exhaust air.

Pneumatic motors such as cylinders powered by compressed air are lubricated to insure free movement of their pistons within the cylinder walls. It is customary to exhaust such cylinders directly to atmosphere during the course of their cycling. The compressed air tends to exhaust explosively which involves two undesirable results. One, a fog of lubricant is blown out of the cylinder into the atmosphere and two, the air exhausts with a relatively sharp report. The lubricant-contaminated air and loud noise are at best unpleasant and frequently constitute health hazards, especially when the equipment is operating within a factory or other enclosed space with human occupants.

Standards adopted by governmental agencies and by industry now require typically that 90 per cent of the lubricant in the exhausting air be removed before the air is discharged to the atmosphere and that the sound of the exhausting air be muffled to a maximum peak impact, A scale, of from 106 decibels to 140 decibels depending upon the particular standard or regulation involved. In addition, the air must be permitted to exhaust rapidly to facilitate cycling of the air motor at normal industrial rates. For example, one large manufacturer specifies that equipment for removing lubricant and muffling the exhaust air shall permit the air to exhaust from a tool in less than 13 cycles, i.e., less than 13/60 seconds. These various requirements tend to work against each other.

The object of the present invention is to provide a relatively simple, inexpensive exhaust air silencer and lubricant remover which is improved to meet all of the requirements discussed above. One form of the invention is shown in the accompanying drawings.

FIG. 1 is an elevational view illustrating an air cylinder and valve in assembly with a silencer and lubricant remover according to the present invention.

FIG. 2 is an enlarged scale central vertical sectional view of the silencer and lubricant trap with parts broken away to illustrate structural detail.

FIG. 3 is a fragmentary plan view of a baffle ring.

FIG. 4 is a fragmentary enlarged scale elevational view taken in the direction of arrow 4 of FIG. 3.

FIG. 5 is a sectional view on line 5—5 of FIG. 2.

Shown in FIG. 1 is an air cylinder **10** having a conventional piston (not shown) to which a piston rod **12** is connected. Cylinder **10** has a head **14** pneumatically connected with a valve **16** by an air line **18.** Valve **16** is operable to admit air under pressure from an air line **20** to cylinder head **14** and to exhaust air from the cylinder into an exhaust air line **22.** A silencer and lubricant trap **24** according to the present invention is connected with exhaust line **22.**

Device **24** has a body **26** comprising a head **28** and a cup **30.** The head and cup are secured together by means of ring **32** threaded onto the head at **34** and having an inward flange **36** which engages the bottom of an outward flange **38** on the cup. Flange **36** clamps flange **38** against a sealing washer **40** which is in turn clamped against a downwardly facing shoulder **42** on head **28.**

Head **28** has an inlet **44** threaded to receive exhaust line **22** and an annular passageway **46** which communicates with the inlet. Passageway **46** opens downwardly into a top portion of cup **30.** Upper interior wall portions **48** of the cup define a continuation of passageway **46.** A baffle ring **50** is mounted within passageway **46, 48.** The structure and mounting of the baffle ring are described in detail below.

Upper interior portion **52** of cup **30** forms an expansion chamber for air entering it from passageway **46, 48** and the lower interior portion of the cup forms a sump chamber **54** for collection of trapped lubricant, the level of which is represented at L. A baffle **56** seats on an annular shoulder **58** in the cup wall. The baffle has slot-like openings **60** through which lubricant drains downwardly from expansion chamber **52** into sump **54.** The baffle shields lubricant in the sump chamber from the flow of air enabling it to collect in the bottom of the cup. Thee bottom of cup **30** has an opening **62** which contains a conventional fitting **64** having a drain cock **66.**

Baffle ring **50** has a circumferentially arranged series of passages **68** around its periphery through which air flows en route from inlet **44** to expansion chamber **52.** In the form of the invention illustrated, these passages are defined by grooves circumferentially separated by vanes **70.** The grooves have helical configuration with substantially uniform cross section throughout their length. The length of the grooves is greater than their cross dimension. Ring **50** has a flange **72** adjacent its top which seats on the top edge **74** of cup **30.** Vanes **70** engage against upper wall portions **48** of the cup so that these wall portions and the vanes cooperate to close the radially outer portions of passages **68.**

Baffle ring **50** has an annular partition wall **76** radially inward of grooves **68** and an annular skirt **78** spaced radially inwardly of partition **76.** Partition **76** and skirt **78** define therebetween an annular gap **80** which has a closed upper end **82** and which opens vertically downwardly into expansion chamber **52.** Partition **76** separates grooves **68** from gap **80.** The partition and skirt **78** have bottom surfaces **84** and **86** respectively which preferably lie substantially on a common horizontal plane.

Skirt **78** has a tubular extension **88** which extends upwardly from baffle ring **50** per se and fits within an opening **90** in head **28.** Opening **90** has an annular, radially inward shoulder **92** and from the shoulder continues axially upwardly at **94** through the top of head **28.** Generally speaking, extension **88** and upper opening portion **94** may be regarded as the outlet from expansion chamber **52.**

A muffler **96** is mounted in the outlet. In the illustrated form of the invention this muffler comprises a pair of truncated conical porous sintered metal elements **98.** These elements are hollow having closed ends **100** and open bases **102.** Bases **102** have interengaged, radially outward flanges **104** disposed beneath shoulder **92** in head **28** and above top **106** of extension **88.** An axially compressible spring **108** is provided between end **106** and base flanges **104.** Spring **108** may comprise a conventional, radially slit ring having vertical waves therein. When ring **32** is tightened, top **74** of cup **30** urges flange **72** and extension **88** upwardly, compressing spring **108** and urging the top one of interengaged flanges **104** against shoulder **92** to secure muffler elements **98** in position. Top **106** has a notch which contains a seal washer **110** engaged against opening **90** in head **28.**

In use, silencer and lubricant trap **24** is mounted in a generally vertical position as shown with exhaust air line **22** threaded into inlet **44.** When air is exhausted from cylinder **10** it passes through line **22** and into circumferential passageway **46.** The air flows downwardly through passages **68** in baffle ring **50** and into expansion chamber **52.** Passages **68** have a considerable length and this length combined with their helical orientation imparts a whirling movement to the air flowing therethrough. When the air exits from passages **68** it both expands and is flung outwardly by the centrifugal force of its whirling movement. The air impinges downwardly and outwardly against the wall of expansion chamber **52** and most of the lubricant carried from cylinder **10** into the expansion chamber becomes deposited upon the expansion chamber wall. Most of the deposited lubricant drains downwardly through openings **60** in baffle **66** and collects in the bottom of sump chamber **54.**

From chamber **52** the air passes through the myriad pores in lower muffler element **98,** passes upwardly through the hollow interiors of the muffler elements and then outwardly through the myriad pores in upper muffler element **98** to the atmosphere. Some of this air passes directly into that part of the lower muffler element which depends into chamber **52.** Some of the air also flows upwardly along portions **112** of cup **30** beneath baffle ring **50,** then radially inwardly past skirt **78,** and then upwardly along the interior surface **114** of tubular extension **88.**

If it were not for gap **80,** some of the lubricant deposited at upper wall portions **112** would be propelled upwardly to baffle ring **50,** across the bottom surfaces of the baffle ring, around the inner corner of skirt **78,** and upwardly along tubular surface **114.** This lubricant would be blown through muffler elements **98** and would be discharged into the atmosphere. The reason for this is that the lubricant characteristically wets the surface on which it is deposited. That is to say, the lubricant spreads out in a thin film on the surface and this film is propelled along the surface by the air flowing thereover.

Gap **80,** however, intercepts this flow of lubricant and also causes turbulence in the air flowing thereacross which interrupts the propelling force of the air on the lubricant. The closed upper end of the gap furthermore provides a relatively dead air space and virtually no lubricant is blown around the surface of this space. Consequently, very little of the lubricant traverses gap **80** to surfaces **86** and **114** from which it could otherwise be propelled upwardly and out of head **28** in the manner described. The intercepted lubricant accumulates on bottom surface **84** of partition **86** and when the accumulation is great enough, it drops downwardly into cup **30.**

It is important that skirt **86** be short enough so that it is protected against impingement of lubricant-bearing air issuing from passages **68.** Otherwise, lubricant would be deposited directly thereon and would be propelled out of head **28** in the manner described.

The flow of air exiting from silencer and lubricant trap **24** is slowed and diffused into myriad paths by the porous material of muffler elements **98.** The effect is to greatly reduce the volume of sound of the air discharging to the atmosphere.

In a typical silencer and lubricant trap **24** according to the present invention, 20 grooves or passages **68** are provided around the periphery of a baffle ring **50** having a diameter of about 2.75 inches exclusive of flanges **72.** Each groove is about 0.187 inches wide, about 0.121 inches deep, about three-fourths inches long from end to end, and extends through an angle of about 19°. Gap **80** has a radial width of about one-fourth inch and axial depth of about one-half inch.

In tests utilizing compressed air at about 80 psi to about 100 psi a typical such silencer and lubricant trap **24** retains about 92 per cent to about 94 per cent of the lubricant carried into it by exhaust air through pipe **22.**

In the same range of pressures the sound of the exhausting air is muffled down to 104 to 105 decibels peak impact, A scale. The total air-exhaust time is about 12 to 12.1 cycles (1 cycle being 1/60 second) utilizing compressed air at about 90 to 100 psi.

Cup **30,** ring **32,** baffle **56,** and muffler elements **98** are standard items used in airline accessories such as lubricators, filters, and moisture traps. Head **28** is also a standard item except that it is modified to receive baffle ring **50,** its extension **88** and muffler elements **98** and is also modified to isolate from the internal air flow path an opening **116** which forms a part of the air flow path in other airline accessories. Baffle ring **50** and extension **88** typically are made integrally from a plastic material such as a polycarbonate.

A silencer and lubricant trap **24** according to the present invention is thus relatively inexpensive and is very effective for its intended purposes.

I claim:

1. A silencer and lubricant trap for air exhausting from pneumatically powered tools which comprises,

means forming a body having an inlet adapted to receive air exhausted from a pneumatic tool,

said body defining an expansion chamber having a wall, a passageway between said inlet and chamber, a lubricant sump below said chamber, and an outlet downstream of said chamber,

baffle means in said passageway effective to direct air flowing therethrough into lubricant-depositing impingement against the expansion chamber wall,

muffler means effective to muffle the sound of air passing through said outlet,

there being surface portions within said body along which air flows toward said outlet,

and at least one gap between certain of said surface portions surrounding the path of said air flow,

said gap being so dimensioned and positioned as to intercept lubricant propelled toward said outlet along those of said surface portions upstream of said gap,

said baffle means comprising a circumferentially arranged series of alternate webs and passages dimensioned and positioned to so divert air flowing through said passages,

said baffle means, said certain surface portions, and said gap comprising elements of an assembly,

said webs and passages being disposed around the periphery of said assembly,

said assembly having a partition which interconnects said webs, forms inner surfaces of said passages, and forms an outer side of said gap,

said assembly having a skirt which is spaced from said partition and forms the inner side of said gap.

2. The structure defined in claim **1** wherein said passages have a length in the direction of air flow therethrough which is greater than their cross dimension.

3. The structure defined in claim 2 wherein said passages have helical form and are oriented to effect centrifugal impingement of said air against said chamber wall.

4. The structure defined in claim 3 wherein said passages have substantially uniform effective sectional area throughout their lengths.

5. The structure defined in claim 1 wherein said partition and skirt terminate in a downward direction substantially at a common horizontal plane and have bottom surfaces comprising said certain surface portions.

6. The structure defined in claim 5 wherein said webs comprise vanes engaged against portions of a wall defining said passageway and forming outer peripheral portions of said passages.

7. The structure defined in claim 6 wherein said body comprises a head and a cup, said head having said inlet and an upstream part of said passageway,

said cup being secured to said head and defining a downstream part of said passageway, said chamber and lubricant sump,

said vanes having flanges secured against the top of said cup by interengaged means on said head and assembly.

8. The structure defined in claim 7 wherein said assembly is annular and has a tubular extension of said skirt extending downstream therefrom, said interengaged means including the downstream end of said extension and means on said head.

9. The structure defined in claim 8 wherein said muffler means comprises at least one porous, sintered metal member having a peripheral portion contained between said downstream end of said extension and said means on said head.

10. The structure defined in claim 9 wherein there are a pair of said members having generally conical shape with interengaged flanged bases, the flanges of which are so contained between said downstream end and means on said head.

11. The structure defined in claim 10 wherein a generally conical portion of one of said members projects through said extension into said expansion chamber, and a generally conical portion of the other of said members projects away from the outlet and exteriorly of said head.

12. The structure defined in claim 8 wherein said assembly comprises a body of plastic material, said elements and tubular extension being integrally formed in said body of material.

13. A silencer and lubricant trap for air exhausting from pneumatically powered tools which comprises,

means forming a body having an inlet adapted to receive air exhausted from a pneumatic tool,

said body defining an expansion chamber having a wall, a passageway between said inlet and chamber, a lubricant sump below said chamber, and an outlet downstream of said chamber,

baffle means in said passageway effective to direct air flowing therethrough into lubricant-depositing impingement against the expansion chamber wall,

there being surface portions within said body along which air flows toward said outlet,

and at least one gap between certain of said surface portions surrounding the path of said air flow,

said gap being so dimensioned and positioned as to intercept lubricant propelled toward said outlet along those of said surface portions upstream of said gap,

said baffle means, said certain surface portions, and said gap comprising elements of an assembly,

said outlet being open to atmosphere, muffler means effective to muffle the sound of air passing through said outlet to atmosphere,

said body and assembly having support means which secure said muffler within said outlet.

14. The structure defined in claim 13 wherein said muffle has a portion which projects into said expansion chamber and a portion which projects beyond said outlet to the exterior of said body.

15. The structure defined in claim 14 wherein said muffler is formed of a porous sintered metal and is hollow.

16. The structure defined in claim 15 wherein each of said muffler portions has the form of a truncated cone with a base, the bases of the cones having interengaged flanges, said flanges being engaged by said support means.

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