Aug. 2, 1966 K. S. ALM 3,263,770

NOISE DEADENING MEANS FOR PERCUSSIVE TOOLS

Filed Oct. 13, 1965 2 Sheets-Sheet 1

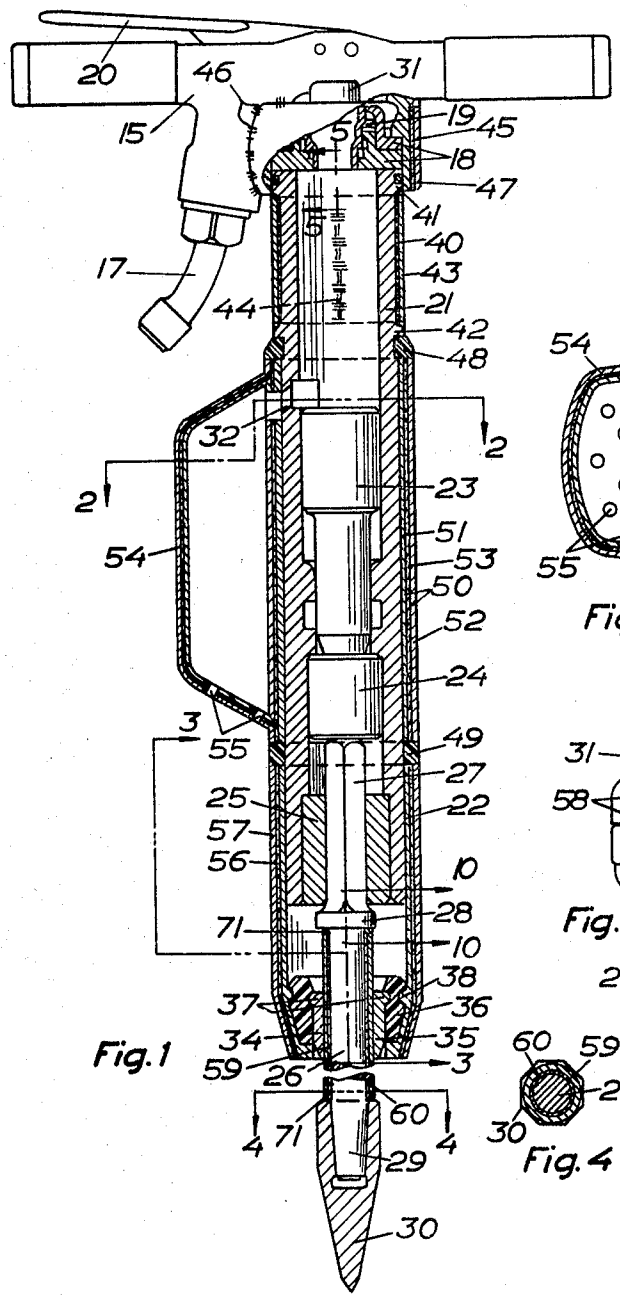

Fig. 1

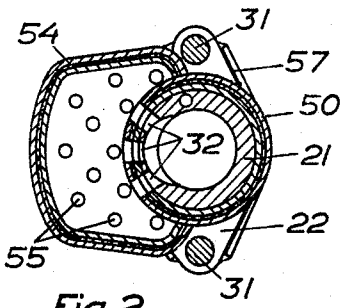

Fig. 2

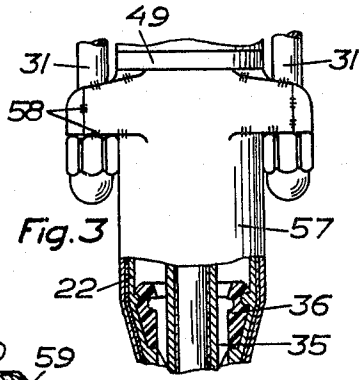

Fig. 3

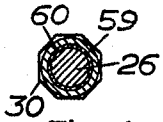

Fig. 4

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NOISE DEADENING MEANS FOR PERCUSSIVE TOOLS

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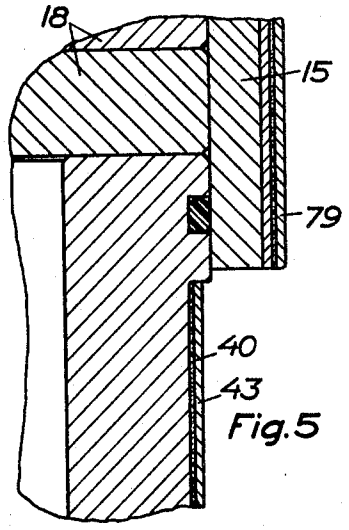

Fig.5

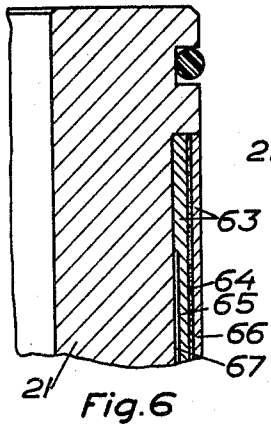

Fig.6

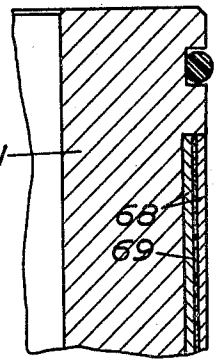

Fig.7

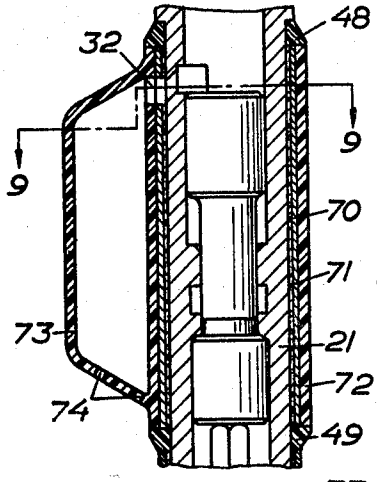

Fig.8

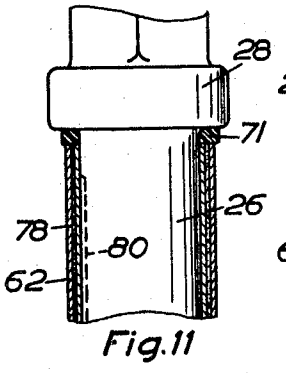

Fig.11

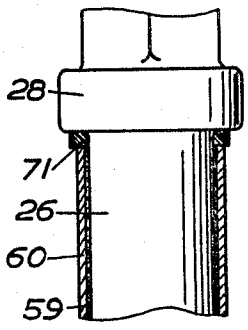

Fig.10

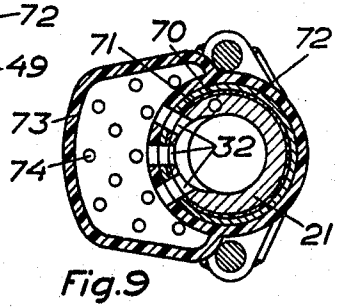

Fig.9

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NOISE DEADENING MEANS FOR PERCUSSIVE TOOLS

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12 Claims. (Cl. 181—36)

The invention relates to means for deadening the noise of percussive machines and of the tools actuated by such machines during their work. Percussive machines normally include an impact motor in which an impact member such as a reciprocating hammer piston may be driven by pressure fluid, by an electric motor via spring and crank means or in other ways. It is common experience that the operation of such machines produces objectionable noise which must be combated in order to increase the working hygiene in the area around the machine. Therefore such machines when driven by pressure fluid have been provided with exhaust noise mufflers. In connection herewith it is easy to establish that the substantial deadening effect of such mufflers lies within the lower frequencies of the machine noise frequency spectrum since machines provided with effective exhaust noise deadening means during operation emit a clearly dominating metallic noise of high frequency. Physiologically high frequency noise is far more dangerous for operators subjected to longtime exposure thereof and is apt to cause remaining loss of hearing powers sooner than noise of lower frequency at the same sound pressure level. It is therefore the primary object of the invention to provide noise deadening means for percussive machines and their tools particularly effective in deadening the metallic high frequency noise thereof.

To this end there is according to one aspect of the invention provided a noise deadening means for percussive machines including a machine housing, a tool insertable with one end thereof into said machine housing, a hammer piston reciprocably mounted in said machine housing for delivering blows to said one end of said tool, and means for reciprocating said hammer piston in said housing, said noise deadening means comprising a coat in surface contact with and outwardly enclosing said machine housing to the major portion of its length, said coat including metallic outer shell portions each separated from said machine housing by an intermediate layer of a vibration damping material, said layer having a thickness smaller than said shell portions.

For analogous purposes there is according to another aspect of the invention provided in a tool adapted for insertion with one end thereof into a percussive machine for transmitting impact energy from said machine to a surface operated upon by the other end of said tool, the combination of said tool with noise deadening means comprising a coat in surface contact with and outwardly enclosing said tool to the major portion of its length, said coat including at least one metallic outer shell portion separated from said tool by an intermediate layer of vibration damping material, said layer having a thickness smaller than said shell.

Thanks to the vibration damping layer the generation of acoustic vibrations at the outer surface of the coated machine housing and instrument is counteracted so that the sound pressure level of the physiologically dangerous high frequency noise can be kept low. By simultaneous use in connection with pressure fluid driven percussive tools of an effective exhaust noise muffler, the noise can be affected as a whole so that a substantial reduction of the sound pressure level can be gained over the entire noise frequency range.

The above and other objects of the invention will become obvious from the following description and from the accompanying drawings in which an embodiment of the invention and some modifications of its constituents are illustrated by way of example. It should be understood that this embodiment and its modifications are only illustrative of the invention and that various other modifications may be made within the scope of the claims.

In the drawings FIG. 1 shows a longitudinal section through a percussive machine according to the invention. FIG. 2 shows a cross section on the line **2—2** in FIG. 1. FIG. 3 is a partial section and side view on the line **3—3** in FIG. 1. FIG. 4 is a cross section on the line **4—4** in FIG. 1. FIG. 5 is a fragmentary section on a larger scale on the line **5—5** in FIG. 1. FIGS. 6 and 7 show two modified embodiments of the parts depicted in FIG. 5. FIG. 8 shows a fragmental longitudinal section through a modified embodiment of the percussive tool in FIG. 1. FIG. 9 is a cross section on the line **9—9** in FIG. 8. FIG. 10 is a section on the line **10—10** in FIG. 1. FIG. 11 finally is a modification of the parts depicted in FIG. 10.

The percussive tool shown in FIGS. 1–5 is a pneumatic breaker or demolition tool for breaking concrete, asphalt and the like and comprises a machine housing including a back head **15**, a cylinder housing **21** and a front casing **22**. The back head **15** carries a pair of handles and an air connection **17** thereon and contains a valve housing **18** with a tube-shaped distributing valve **19** and a conventional throttle valve, not shown in detail, operable by means of a handle **20**.

The cylinder housing **21** extends into the back head **15** and projects with the forward end thereof into the front casing **22**. A hammer piston **23** of differential piston type is reciprocable in the cylinder housing **21**. The hammer piston **23** delivers its blows against an anvil block **24** which is slidably guided in a bore in the forward end of the cylinder housing **21**. The bore receiving the anvil block **24** is closed forwardly by a tool bushing **25** which receives the neck **27** of the tool in its suitably profiled interior.

In the illustrative example the tool is a pick **26** having a square neck **27** and a collar **28**. The forward end **29** of the pick **26** is conical and carries a suitably wedge shaped demolition edge **30** thereon.

The machine housing parts **15**, **21**, **22** are kept together by a pair of axial tension bolts **31** which are tensioned between radial ears provided respectively on the back head **15** and on the front casing **22**.

Compressed air is supplied by a hose, not shown, to the air connection **17** and is delivered to the distributing valve **19** upon actuation of the handle **20**. The valve **19** distributes compressed air via passages, well known in the art and therefore not shown in detail, alternately to the opposite ends of the hammer piston **23** whereby the hammer piston is reciprocated and delivers blows to the anvil block **24** and on to the neck **27** and the pick **26**. Compressed air is exhausted from the cylinder housing **21** via centrally arranged exhaust passages **32**.

The pick **26** is kept in place removably in the front casing **15** of the machine housing **15**, **21**, **22** by means of axially divided semi-cylindrical guiding cups **34**, **35** carried by a rubber cylinder **36** in which they are resiliently retained by means of rear beads **37**. The rubber cylinder **36** is in its turn retained in the interior of the front casing **22** by means of an inner bead **38** provided forwardly and at the inside of said casing **22**. The guiding cups **34**, **35** can be pushed axially into the interior of the front casing **22** and laterally out of the path of the collar **28** so that the pick **26** can be removed. By reinserting the neck **27** of the pick **26** into the tool bushing **25** and thereupon by pushing the guiding cups **34**, **35** by

means of the collar **28** in turn from the interior of the front casing **22** into the rubber cylinder **36** to the retaining position illustrated in FIG. 1, the guiding cups **34**, **35** will form a tool holder for resiliently retaining the pick **26** in place.

For deadening the metallic noise arising during operation of the above and other percussive machines the machine housing and the tool thereof are to the largest possible extent enclosed or clad by a coat of metallic shell portions. Under each shell portion there is disposed a thin and therefore easily cooled vibration damping layer intermediate each shell portion and the tool housing and tool so that the generation of sound waves at the surface of the shell portions is suppressed to a substantial degree. In order to provide good temperature diversion the vibration damping layer is given a thickness equal to or smaller than 0.7 mm. for machine housings generally as well as for drill steels, and preferably equal to or smaller than 0.5 mm. for tools such as picks. The working conditions are usually a vibration spectrum lying between 100 Hertz and 8000 Hertz and working temperatures varying locally along the machine housing and in the tool usually between −40 and +130 degrees centigrade. Within these working conditions some rubber sorts for example butyl rubber, may form the vibration damping layer. It is more advantageous, however, to use some other high polymer material having more marked viscoelastic properties within the actual temperature and vibration frequency limits.

A material is considered to be viscoelastic if it is capable during mechanical deformation on the one hand to store and to give off deformation energy elastically and on the other hand to absorb simultaneously therewith a substantial part of the deformation energy. Within varying temperature intervals many polymers have marked viscoelasticity, for example cold curing polysulphide rubber, polymers of vinyl acetate, acrylic ester, vinyl propionate, vinyl acetate and vinyl chloride alone or in mixture or in some cases with an addition of a suitable softener. The usually narrow marked viscoelastic temperture interval can be influenced as to its position and width by suitable variation of the mixture components. In the polymer or polymer mixture, mica or graphite or preferably the mica-mineral vermiculite can be mixed in proportions of 20–60%. Especially vermiculite expanded through heating is advantageous because of its porosity.

In the various points of the machine one can thus choose, in dependence upon the local working temperature in the point in question, a vibration damping high polymer material composition which within the actual frequency limits contains said working temperature within its viscoelastic temperature interval. As examples of suitable layer compositions may be mentioned:

(1) 80% polyvinyl acetate
20% dibutyl phthalate (softener)

These components form a composite paste with vermiculite in the proportions 40/60%.

(2) Polyvinyl propionate with between 40 and 60% graphite or vermiculite.

In practice, however, the selection of a suitable material for the layer will usually be simplified by choosing a single layer material for the entire machine, for example cold curing polysulphide rubber or a suitable addition polymer or mixture including the materials mentioned above.

A vibration damping layer **40** of the above described character is placed on the outer surface of the cylinder housing **21** between two flagnes **41**, **42** thereon. A coat of a thin steel sheet **43** is placed tightly over the layer **40** around the cylinder housing **21** and joined at the abutting edges thereof along a seam **44** as by welding. In a similar manner the back head **15** is coated at least around its portions surrounding the valve housing **18** by a vibration damping layer **45** surrounded by a metal sheet **47** spot welded to the back head **15** at **46**. Against the flange **42** of the cylinder housing **21** rests a rubber ring **48** and therebetween and between a similar rubber ring **49** supported by the front casing **22** forwardly on the cylinder **21** there is kept in place a thin steel tube **50** surrounding the cylinder housing **21**. The tube **50** consists of laminated sheet material including a duality of thin steel sheets with an inner cylinder **51** and an outer cylinder **52** concentric therewith. The cylinders **51**, **52** may be of equal, FIG. 1, or of different thickness. Between the cylinders **51**, **52** is disposed a vibration damping layer **53**. In connection with the exhaust openings **32** there is carried an exhaust noise muffler **54** on the tube **50** which muffler also is constructed of laminated metal sheets and a vibration damping layer therebetween in a manner similar to the tube **50**. The box shaped muffler **54** has downwardly pointing exhaust openings **55**.

Similarly the front casing **22** is covered by a vibration damping layer **56** and coated by a steel sheet **57** which is suitable spots as at **58** is spot welded to the front casing **22**.

The intermediate portion of the pick **26** is cylindrical and is also covered by a vibration damping layer **59** which is surrounded by a metallic tube **60** resting against opposed rubber rings **71** respectively adjacent the neck **28** and the rear end of the breaking edge **30**, FIGS. 1 and 10. As an alternative the pick **26** as depicted in FIG. 11 can be clad by a laminated sheet metal tube **62** in which the vibration damping layer **78** lies between concentric sheet metal tubes. An air gap **80** can as an alternative be provided between the pick **26** and the laminated tube **62**.

In the modification illustrated in FIG. 6 the rear portion of the cylinder housing **21** is coated by a laminated material sheet **63** having an intermediate vibration damping layer **64** between an inner metal sheet **65** and an outer metal sheet **66** thereof. An air gap **67** may be arranged between a portion of the inner sheet **65** and the cylinder housing **21**.

In the embodiment illustrated in FIG. 7 is used a laminated material sheet **68** fitted around the cylinder housing **21** and having an intermediate vibration damping layer **69** and an inner metal sheet of equal thickness or, as an alternative thicker than the outer sheet. Laminated sheet material **79**, FIG. 5, having an intermediate vibration damping layer and inner and outer metal sheets, can also be placed around the back head **15** instead of the plate **47** and the damping layer **45**.

In the embodiment illustrated in FIG. 8 a noise deadening tube **70** disposed between rubber rings **48**, **49** consists of a single steel cylinder surrounding a vibration damping layer **71** on the cylinder housing **21**. Around the cylinder **70** is placed a tube **72** of hard rubber and an exhaust muffler **73** formed integral therewith provides a rubber-walled box shaped chamber adjacent to the tube **72**. The muffler **73** has exhaust openings **74** in its lower bottom portion.

What I claim is:

1. Noise deadening means for percussive machines including a machine housing, a tool insertable with one end thereof into said machine housing, a hammer piston reciprocably mounted in said machine housing for delivering blows to said one end of said tool, and means for reciprocating said hammer piston in said housing, said noise deadening means comprising a coat in surface contact with and outwardly enclosing said machine housing to the major portion of its length, said coat including metallic outer shell portions each separated from said machine housing by an intermediate layer of a vibration damping material, said layer having a thickness smaller than said shell portions.

2. Means according to claim **1** in which said vibration damping layer has a thickness smaller than 0.7 millimeter.

3. Means according to claim 1 in which said coat consists of composite shell portions of laminated sheet material having an outer and an inner metallic sheet at opposite sides of said vibration damping intermediate layer.

4. Means according to claim 1 in which said vibration damping layer consists of a high polymer material having marked viscoelasticity at the working temperatures and the working vibration frequencies of said machine.

5. Means according to claim 4 in which said layer includes addition polymers of vinyl acetate, acrylic ester, vinyl propionate, vinyl chloride, or similar material alone or in mixture and with a voluntary addition of a softener.

6. Means according to claim 5 in which said high polymer material mixture contains between 20–60% vermiculite, graphite or mica.

7. Means according to claim 1 with said means for reciprocating said hammer piston being a pressure fluid delivered to said machine housing, and outlet means on said machine housing for discharging said pressure fluid therefrom, in which an exhaust noise muffler is connected to said outlet means.

8. In a tool adapted for insertion with one end thereof into a percussive machine for transmitting impact energy from said machine to a surface operated upon by the other end of said tool, the combination of said tool with noise deadening means comprising a coat in surface contact with and outwardly enclosing said tool to the major portion of its length, said coat including at least one metallic outer shell portion separated from said tool by an intermediate layer of vibration damping material, said layer having a thickness smaller than said shell.

9. A tool according to claim 8 in which said vibration damping layer has a thickness equal to or smaller than 0.5 millimeter.

10. A tool according to claim 8 in which said coat consists of at least one composite shell portion of laminated sheet material having an outer and an inner metallic sheet at opposite sides of said vibration damping intermediate layer.

11. A tool according to claim 8 in which said vibration damping layer consists of a high polymer material having marked viscoelasticity at the working temperatures and the working vibration frequencies of said tool.

12. Noise deadening means for percussive machines including a machine housing, a tool insertable with one end thereof into said machine housing, a pressure fluid driven hammer piston reciprocably mounted in said machine housing for delivering blows to said one end of said tool, means for delivering pressure fluid to said machine housing in a manner to reciprocate said hammer piston in said machine housing, and outlet means on said machine housing for discharging said pressure fluid therefrom, said noise deadening means comprising an exhaust noise muffling casing connected to said outlet means for receiving pressure fluid discharged therefrom, the walls of said casing being formed by laminated sheet material having an outer and an inner metallic sheet at opposite sides of an intermediate layer of vibration damping material, and exhaust openings connecting the interior of said casing to the atmosphere.

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