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EXHAUST NOISE REDUCING AND AIR DIFFUSING MEANS FOR PNEUMATIC MOTORS

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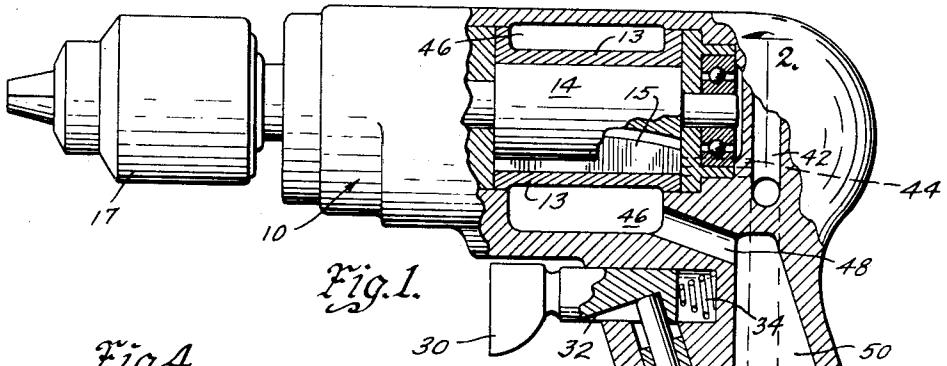


Fig. 1.

Fig. 4.

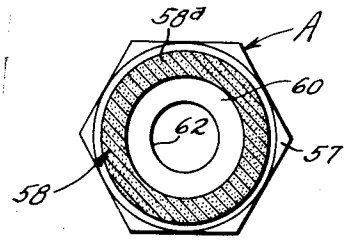


Fig. 2.

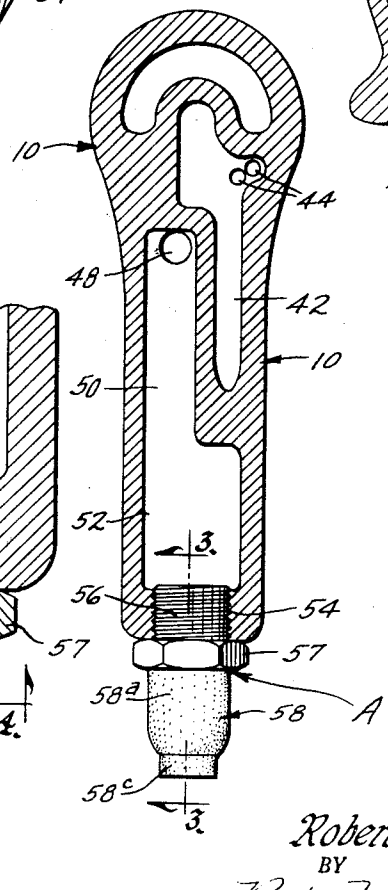
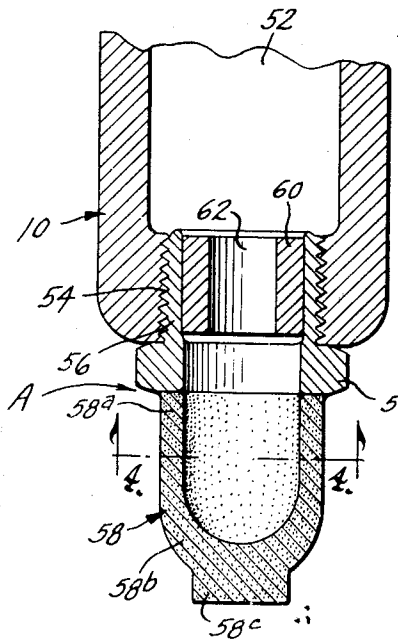


Fig. 3.



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EXHAUST NOISE REDUCING AND AIR DIFFUSING MEANS FOR PNEUMATIC MOTORS

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8 Claims. (Cl. 181—36)

This invention relates to exhaust noise reducing and air diffusing means for a pneumatic motor of the type for operating drill chucks and similar tools, the motor being of vane or other type wherein the exhaust air is discharged in pulsations therefrom.

One object of the invention is to provide means to dampen the sound waves, pressure variations or pulsations produced by the successive exhausting of quantities of relatively high pressure air from the space between the vanes of the motor.

Another object is to quiet the hiss, roar, whine or scream of the jet stream issuing from the exhaust of the motor itself by passing it through a sound dampening chamber and then through a novel air diffusing means into the surrounding atmosphere.

Still another object is to provide a sound dampening chamber associated with the motor exhaust and which is so related in volume to the entrance and exit areas of the sound dampening chamber as to secure the desired sound dampening effect.

A further object is to provide air diffusing means of novel character at the final exhaust point of the noise reducing and air diffusing system consisting of sintered metal of such porosity and area as to reduce the velocity of the issuing air to such extent as to eliminate hiss or roar and to also eliminate discomfort to the operator or others near him by extreme mutual interference of the streams of air issuing from the exhaust surface of the air diffuser.

With these and other objects in view, my invention consists in the construction, arrangement and combination of the various parts of my exhaust noise reducing and air diffusing means for pneumatic motors, whereby the objects above contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and illustrated in detail on the accompanying drawing, wherein:

Fig. 1 is a full size side elevation, partially in section, of a pneumatic drill motor with my invention applied thereto;

Fig. 2 is a vertical sectional view on the line 2—2 of Fig. 1;

Fig. 3 is an enlarged vertical sectional view on the line 3—3 of Fig. 2 showing details of an air diffuser; and

Fig. 4 is a horizontal sectional view on the line 4—4 of Fig. 3.

On the accompanying drawing I have used the reference numeral 10 to indicate in general a pneumatic tool such as a "pistol grip" drill in which the handle is shown at 12 and the drill chuck at 17. The pneumatic motor of the tool 10 includes a rotor 14 in a stator 13 and is usually of the vane type in this size of motor. One of the vanes is shown at 15. Both the vane type and other types such as those operated by cylinders and pistons exhaust air in pulsations that produce sound waves because of the pressure variations as the exhaust air issues from the motor and the noises generated may take the

form of a hiss, roar, whine or scream. The primary object of my present invention is to eliminate these sounds as much as possible so that a quietly operating pneumatic tool results.

A compressed air supply hose 16 connects by means of a bushing 18 to the handle 12, and a valve seat 20 formed on a sleeve 36 in the handle has an inlet valve 22 normally seated thereagainst by a spring 24. The valve 22 is provided for controlling the supply of air to the motor 13—14. A stem 26 extends upwardly from the valve 22 and a slidable pin 28 forms an extension thereof under control of a trigger 30 having an inclined surface 32 for propelling the pin 28 downwardly and thereby opening the valve 22 with respect to the seat 20 when the trigger 30 is depressed against the action of a return spring 34. The air from the bushing 18 thereupon passes through the valve seat 20 and then through lateral openings 38 of the sleeve 36 whereupon it enters an annular cavity 40 and a passageway 42 leading to inlet openings 44 (see Fig. 2) that in turn leads to the inlet side of the motor 13—14.

The motor exhaust discharges into an annular passageway 46 surrounding the motor and then travels through an opening 48 into an enlarged sound dampening chamber 50 in the handle 12. This chamber 50 has a further enlargement at 52 as shown in Fig. 2 which terminates in a threaded outlet 54.

An air diffuser fitting A is threaded into the outlet 54 and consists of a metal threaded part 56 and a sintered metal air diffuser part 58. A reducer bushing 60 is pressed into the threaded part 56 to provide a predetermined area of outlet opening 62 for the sound dampening chamber 50—52.

For efficient operation of my exhaust noise reducing and air diffusing system, I find that some proportional relationship between the parts is necessary although the proportions may vary within rather wide limits. The first consideration is the area of the inlet opening 48 to the sound dampening chamber 50—52. This area is such that the pressure of the issuing air is between 5 and 15 pounds per square inch gauge. The volume of the chamber 50—52 may vary between ½ and 1½ cubic inches per 20 cubic feet of air flow per minute (c.f.m) and the area of the outlet opening 62 from the sound dampening chamber 50—52 is in about the same range as the area of the opening 48.

The inside area of the sintered metal air diffuser 58 needs to be about 10 to 20 times the area of the opening 48 or the opening 62, and the porosity of the metal (or the pore size thereof) should be less than 100 microns for satisfactory results.

I have found that when the parts have the range of proportions indicated, the sound wave or pulsations as well as the hiss or roar of the exhaust are quieted so as to be nearly imperceptible. At the same time the final exhaust of air from the outer surface of the diffuser 58 has a velocity so low there is no hiss nor any personal discomfort to the user or those near him, even when the exhaust surface is within a few inches of the face or hand. This extremely low velocity of each tiny jet through a porous material sets up extreme interference of one jet stream with another after leaving the exhaust surface because in a sintered metal the direction of exit from each pore is at random and the pores are not all parallel so reduce directivity, and furthermore they provide tortuous paths through the thickness of the material 58 thus tending to reduce velocity even further.

I have found sintered bronze to be a suitable material for the element 58 and it may be brazed during the sintering process to the fitting 56 which may be of brass or the like. The shape of the element 58 has significance

to the extent that it provides an increase in area over and above the disc area of the exit opening **62** of the bushing **60**, and the wall thickness may be varied somewhat to increase or decrease the over-all porosity of the diffuser **58**. It may also be thickened as at **58**^{b} and **58**^{c} in the path of most direct air discharge from the bushing **60** to render substantially equal air discharge from the diffuser A or to provide areas and/or directions of less discharge if desired.

From the foregoing specification it will be obvious that I have provided the combination of a sound dampening chamber and an exhaust air diffuser which avoids personal discomfort in addition to providing a quietly operating tool. It is believed that the disclosure herein is an approach to the entire problem of exhaust noise that provides a novel solution thereto.

Some changes may be made in the construction and arrangement of the parts of my exhaust noise reducing and air diffusing means for pneumatic motors without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified forms of structure or use of mechanical equivalents which may reasonably be included within their scope.

I claim as my invention:

1. Exhaust noise reducing and air diffusing means for pneumatic motors comprising an air diffuser, a sound dampening chamber between the motor and said air diffuser, said chamber having an inlet opening from the motor and an outlet opening to said air diffuser, said air diffuser comprising a porous metal discharge fitting beyond said outlet opening, the area of the porous metal being approximately 15 times the area of said outlet opening.

2. Exhaust noise reducing and air diffusing means for pneumatic motors comprising an air diffuser, a sound dampening chamber between the motor and said air diffuser, said chamber having an outlet opening from said chamber, said chamber having a volume of approximately 1 cubic inch per 20 c.f.m. of air flow from the motor, said air diffuser comprising a sintered metal discharge fitting in which the pore size is less than 100 microns and the area of said sintered metal diffuser being approximately 15 times the area of said outlet opening from said sound dampening chamber.

3. Exhaust noise reducing and air diffusing means for pneumatic motors comprising an air diffuser, a sound dampening chamber between the motor and said air diffuser, said chamber having an inlet opening, an outlet opening from said chamber, said chamber having a volume of approximately ½ to 1½ cubic inches per 20 c.f.m. of air flow from the motor, said air diffuser comprising a sintered metal discharge fitting in which the pore size is below 100 microns, and the area of said sintered metal diffuser being approximately 10 to 20 times the area of said outlet opening from said sound dampening chamber.

4. Exhaust noise reducing and air diffusing means for pneumatic motors comprising an air diffuser and a sound dampening chamber between the motor and said diffuser, said chamber having an inlet opening the area of which is such as to reduce the air pressure to approximately 5 to 15 p.s.i.g., an outlet opening from said chamber of substantially the same area, said air diffuser comprising a sintered bronze discharge fitting having an area approximately 15 times the area of said outlet opening from said sound dampening chamber.

5. Exhaust noise reducing and air diffusing means for pneumatic motors comprising an air diffuser and a sound dampening chamber between the motor and said air diffuser, said air diffuser comprising a metal element threaded into said chamber and having a bushing therein, the bore of which constitutes an outlet opening from said chamber, and a sintered bronze cap brazed to said metal element and axially elongated to increase the surface area thereof compared to the area of the bore of said bushing.

6. An air diffusing means for a pneumatic motor comprising an element threaded into the air exhaust outlet from the motor, said element having a bore therethrough, and a sintered metal cap receiving air from said element, the surface area of said cap being 10 to 20 times the area of the bore of said element.

7. An air diffuser for the exhaust from a pneumatic motor comprising a tubular fitting, the bore of which constitutes an outlet opening, and a porous metal cap having a surface area greater than the disc area in said bore of said fitting.

8. An air diffuser for the exhaust from a pneumatic motor comprising a tubular fitting, the bore of which constitutes an outlet opening, and a porous metal cap having a surface area greater than the disc area in said bore of said fitting and a pore size less than 100 microns.

References Cited in the file of this patent

UNITED STATES PATENTS

2,561,726	Cherain	July 24, 1951
2,600,236	Gibel	June 10, 1952
2,678,637	Doeden	May 18, 1954