United States Patent

Blatt et al.

[15] **3,672,465**

[45] **June 27, 1972**

[54] GAS EXHAUST SILENCER

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[22] Filed: **Oct. 15, 1970**

[21] Appl. No.: **81,051**

[52] **U.S. Cl.** **181/50,** 181/57, 181/60, 181/68, 181/71

[51] **Int. Cl.** **F01n 1/10,** F01n 7/16

[58] **Field of Search** 181/42, 47, 47.1, 50, 56, 57, 181/60, 71, 63, 68–70

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[57] **ABSTRACT**

An air exhaust silencer comprises a housing having an air inlet and an air outlet defined by baffle members made of a porous material; a sound absorbing material is disposed in the housing between the baffle members; the air enters through the inlet port and is broken up by the porous inlet baffle for distribution through the sound absorbing material and exhaust through the porous outlet baffle at which the air flow is further broken up to thereby considerably reduce the noise level of the exhausted air passing through the silencer.

7 Claims, 4 Drawing Figures

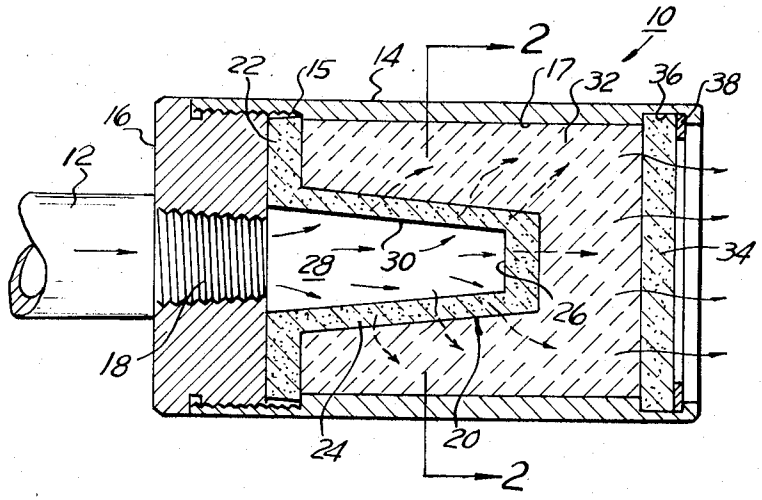

FIG. 1

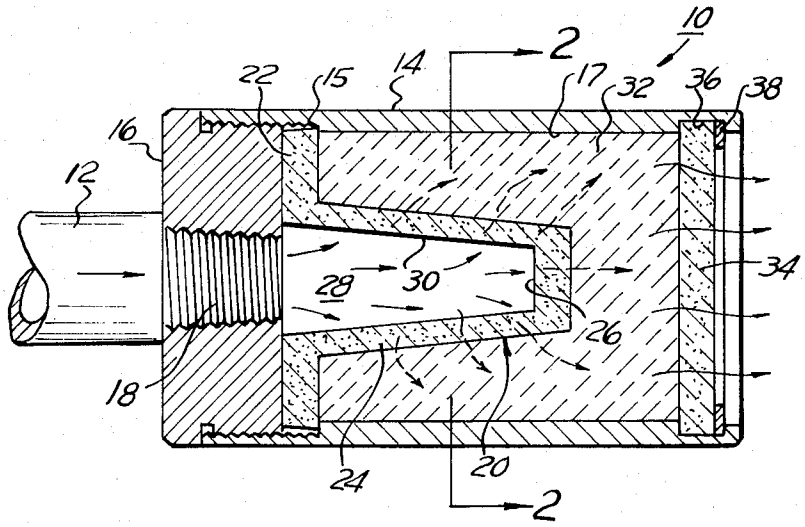

FIG. 2

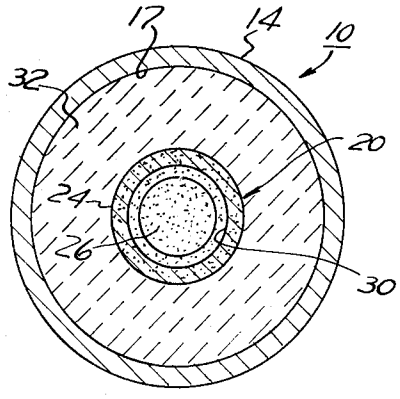

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FIG. 3

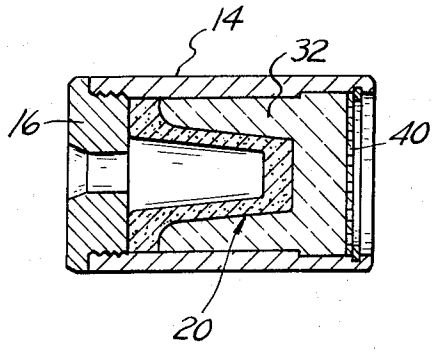
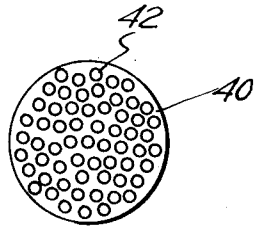


FIG. 4



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GAS EXHAUST SILENCER

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to sound absorbing devices and more in particular to a noise subduing device to maintain a specific noise level within acceptable limits.

Almost universally, every thing, substance or matter moving provides or produces noise at varying frequencies and at different noise levels which may range from a low frequency whisper to high frequency squeals.

Any consistent sound at whatever noise level is, in most cases, annoying to the human ear, although the sound level may not be as high as to produce a health hazard. However, in connection with machinery, whether it be mechanical, electrical or fluid power operated or by combustion, noises are produced which, in instances, exceed a safe level, particularly at high frequencies.

It is known in the industry that the federal government established industrial safety standards by the provision of the Walsh-Healey Act which was amended on May 8, 1969, in regard to occupational noise exposure, setting a standard providing that a person may not work more than 8 hours at a maximum 90 dBA (90 decibels measured on the A-scale of a sound level meter).

Many noises produced in a plant or similar working place, are considerably on a higher scale than 90 dBA . Most of these noises are not merely pure tones, but in most cases are a combination of sounds and may range from a low frequency roar to a high frequency squeal. Obviously, combined frequencies require differentiating of materials inside the device to stop or absorb those frequencies or separate those frequencies in order that they not be added or combined with one another to produce a sound level unacceptable or unhealthful to human beings. Another factor to be considered is the power level of the sound field. Thus, if a great deal of noise is being produced at different frequencies, or the level of power is high, it would require extremely large and complicated silencers to reduce the noise to within a tolerance acceptable to a human being at a certain distance from the origin of the sound.

As mentioned before, sound is produced by matters or substances flowing or moving through the air or through another substance and the noise level of the sound is dependent on the pressure and speed of movement of the moving substance and the relative resistance of the matter or other substance through which the moving substance moves. Thus, air flowing through the orifice or venturi of an exhaust valve at relatively high speed and pressure, creates a high frequency squealing sound, whereas, for instance, the sound produced inside of air operated tools is much more subdued, but this sound is combined with the noise created by the working parts of the tool. Thus, these two examples require different types of sound absorbing material for effective silencing to within a safe level.

Considerable difficulties are experienced in moderating or absorbing these sounds created by the exhaust of pneumatic valves, motors and other air operated tools in the industry. Noise is also produced by the sound of mechanical movement of the working parts of the tools coupled with other frequencies caused by air vibrations as air travels through a particular valve or pneumatic motor.

It is known to the men skilled in the art of noise reduction or absorbtion that, when the daily noise exposure is comprised of two or more periods of noise, the different level and combined effect should be considered rather than the individual effect of each.

In most air tool and/or air valve applications, where a great deal of air flow is present, requires the design of silencer chambers to be of utmost consideration so as not to creat excessive back pressure within the tool or valve which will cause a slow-down in the cycle of the operation time.

Accordingly, the present invention provides an improved air exhaust silencer construction adapted to effectively reduce high noise levels to a safe level not exceeding 90dBA.

The present improved construction comprises a housing which has an inlet connected to the air exhaust conduit and which is filled with a sound absorbing material of a known substance which is retained at both ends of the housing between baffle members made from porous material. One of the baffle members which are axially located in the housing defines a high noise air inlet and the other baffle member defines a low noise exit to the atmosphere.

Thus, the exhausted air from the respective noise producinG apparatus enters the housing through the inlet and impinges against the first porous baffle member which acts to minutely breakup the air stream for distribution through the intermediate sound absOrbing material and final exit through the second porous baffle member at a considerably reduced noise level.

The present invention will be best understood by reference to the following detailed description with particular reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings illustrate a preferred embodiment of the improved silencer structure in which:

FIG. 1 is a longitudinal cross-section through the present improved silencer structure;

FIG. 2 is a transverse cross-section through the structure of FIG. 1 as seen along line 2—2 thereof;

FIG. 3 is a longitudinal cross-section through a modified silencer similar to FIG. 1 constructed in accordance with the present invention; and

FIG. 4 is a detached detail view of the alternate end baffle member employed in the modification of FIG 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the attached drawings and particularly FIGS. 1 and 2, the present improved air exhaust silencer structure comprises a housing generally indicated at **10** which, at one end, is attached to an exhaust pipe or conduit **12** having connection to a noise producing device (not shown).

The silencer housing **10** may be of generally cylindrical or barrel like structure comprising an open-ended tubular member **14** which may be of suitable heat resistant material as generally employed in silencer structures of this kind. One end of the cylindrical member **14** is closed by a front end cap **16** which has a threaded bore **18** for attachment to the air exhaust pipe **12** and which defines the inlet into the silencer.

Inwardly of the cylindrical member **14** and directly adjacent the end cap **16** a baffle member **20** is provided composed of a radial flange portion **22** which is clamped between the end cap **16** and a radial shoulder **15** of the cylindrical member **14** to securely retain the baffle member within the housing. The baffle member **20** is formed into a frustoconical section **24** which axially inwardly extends through the cylindrical member **14** a substantial distance, having an inner closed end **26**. The frustoconical portion **24** of the baffle member **20** is in axial alignment with the inlet **18** to form an expansion chamber **28**. The frustoconical portion **24** is of sufficient length to provide a sufficiently large internal surface area **30** for impingement of the exhaust air thereon and has a sufficient chamber area to accommodate free expansion of the exhaust air entering the chamber **28** from inlet **18**.

The baffle member **20** is made of a gas permeable material which may be heat resistant and having a high porosity such as sintered bronze or the like, to permit the expanded air to enter the cylindrical chamber **17** from the expansion chamber **28** through the porous walls of the truncated cone section **24**.

The cylindrical chamber **17** of the cylindrical member **14** is filled with a sound absorbing material **32** of any known suitable material composition usually employed in silencer applications of this kind, which may include porous urethane, sponge rubber, felt, steel wool, coiled screening and the like. All of these materials have different effects in absOrbing sound at various frequencies.

The opposite exit end of the cylindrical member 14 is closed by another baffle member 34, which comprises a substantially solid plate supported within a radial recess 36 provided in the cylindrical member 14, and retained in position by means of a lock ring 38.

The plate like baffle member 34 is likewise composed of a gas permeable material having a high porosity, such as for instance sintered bronze, to permit exit of the muffled air from the chamber 17 to the atmosphere.

In operation: exhausted air, which may be hot in the case of combustion gas exhaust, enters the silencer structure 10 through the conduit 12 and inlet 18 for entrance into the expansion chamber 28 of the frustoconical portion 24 of the first baffle member 20. The exhausted air is expanded in chamber 28 and impinges radially and axially against the internal surface 30 thereof for penetration through the porous walls of the first baffle member 20 into the chamber 17 of the cylindrical member 14 to penetrate through the sound absorbing material 32, as indicated by the flow arrows.

The initial sound level of the exhausted air, as it enters the expansion chamber 28, is first considerably reduced by being minutely broken up as the air penetrates through the porous walls of the first baffle member into the main chamber of the silencer. During penetration of the air through the sound absorbing material 32, the sound level is further reduced to a still lower value.

The air then travels through the sound absorbing material 32 towards the rear of the silencer for impingement upon the second, plate like baffle member 34 and penetration therethrough to the atmosphere. The plate like exit baffle member 34 further breaks up the air flow as it penetrates through the porous structure of the baffle member to thereby still further reduce the noise level as the air exits to the atmosphere.

With reference now to FIGS. 3 and 4, the embodiment is substantially similar to the embodiment in FIGS. 1 and 2 and similar parts are identified by the same reference numerals.

In the silencer of FIGS. 3 and 4, the second outlet baffle member 34 has been replaced by a perforated plate 40 which, as seen in FIG. 4, is provided with a plurality of holes or apertures 42. The perforated plate 40 is preferably made of aluminum and the sound absorbing material 32 in this instance is preferably an open cellurethane.

This silencer construction is particularly applicable for installation on air venturies which run on low PSI but normally create sounds of annoying frequencies.

The improved silencers of the present invention as disclosed herein, are particularly applicable to absorb sounds created by air flowing from a pipe such as through an exhaust valve and, depending on the selection of suitable material, to reduce other noises such as produced by air tools, combustion engines or the like.

It will be understood that for any particular application, the sintered bronze used must be of suitable density to provide a specified pressure drop per square inch for 1 cubic foot air passage per square inch, which, of course, varies with the individual application.

Thus, the present invention provides an improved, highly effective, air exhaust silencer of relatively simple structure which meets the requirements of the recently amended Walsh-Healey Act concerning occupational noise exposure and which specifies a maximum noise level of 90 decibels during any 8 hour period.

The present improved silencer is constructed to reduce the noise level of exhausted air, and particularly industrial air exhaust, to well below the required value by the provision of oppositely disposed, porous, gas permeable baffle members at both ends of an intermediate sound absorbing media to obtain multiple noise level reduction as the exhausted air travels through the silencer.

It will be appreciated that in some applications where moist air is present expanding through orifices at a very high rate, the exhausting air may take on so much heat that the silencer attached to the air outlet will freeze solid. In these types of applications, additional units may have to be applied or, conversely, the silencer unit will have to be attached as close as possible to the air motor to permit the frictional heat of the working parts to be transmitted into the silencer to keep the cooling effect above the freezing point.

The present improved silencer structures has been tested to not exceed an allowable limit of 85 dBA at 100 psi air pressure with a minimum of back pressure within the silencer, in comparison to a similar length of standard pipe to which the silencer is attached. Thus, as the air pressure is reduced, the silencer ratings will be proportionately reduced. Since most industrial plants specify a pneumatic pressure range between 60 and 80 pounds, several silencers may be working at any one interval without producing a sound effect above the acceptable limits set by the provision of the Walsh-Healy Act, as mentioned above.

While sintered bronze has been referred to in the illustrative embodiments of the invention, other materials which would be regarded as equivalent thereto include sintered steel, porous porcelain or stone or porous plastic materials.

The present invention may be embodied in certain other forms without departing from the spirit and essential characteristic thereof, therefore the present embodiment is to be considered illustrative only and not restrictive, the scopie of the invention being indicated by the appended claims rather than by the foregoing description.

Having described our invention, reference should now be had to the following claims.

We claim:

1. A silencer comprising a housing having a chamber; a sound absorbing material disposed within said chamber; one end of said housing being connected to a source of exhausted air; a first baffle member disposed within said housing adjacent said one end; a second baffle member disposed within said housing adjacent the other end thereof; said first and said second baffle members being permeable to permit penetration of said exhausted air through said first baffle member into said chamber and through said sound abosrbing material for exit through said second baffle member to the atmosphere; said first baffle member being adapted to reduce the noise level of said exhausted air to a first value lower than the initial entering value; said sound absorbing material within said chamber being adapted to further reduce the noise level of said exhausted air to a second value lower than said first value; and said second baffle member being adapted to still further reduce the noise level of said exhausted air to a third value lower than said first and second value;

said first baffle member being formed in the shape of a truncated cylindrical cone providing an internal gas expansion chamber aligned with said inlet and said second baffle member being formed in the shape of a plate disposed across said other end of said housing.

2. The silencer as defined in claim 1, said first and second baffle members being made from sintered bronze.

3. The silencer as defined claim 1, in which said second baffle member comprises a perforated plate.

4. The silencer as defined in claim 1, wherein the apex of the cone is remote from the inlet to the chamber.

5. The silencer as defined in claim 1, wherein the first baffle member is of sintered bronze.

6. The silencer as defined in claim 5, wherein the second baffle member is a perforated plate.

7. The silencer as defined in claim 4, wherein the first baffle member is of sintered bronze.

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