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J. JEFFORDS

2,943,695

SILENCER

Filed Oct. 23, 1957

3 Sheets-Sheet 1

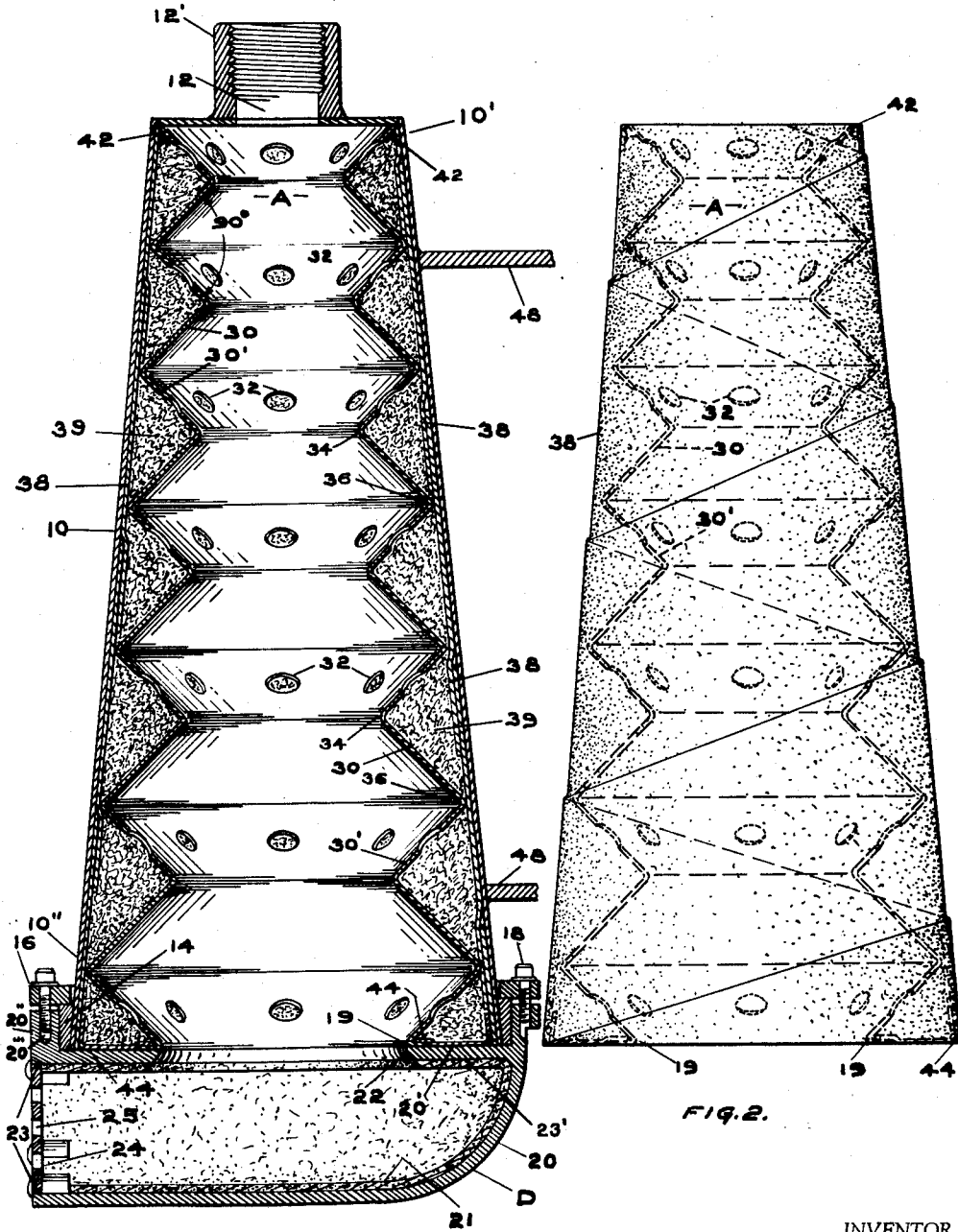


FIG. 1.

FIG. 2.

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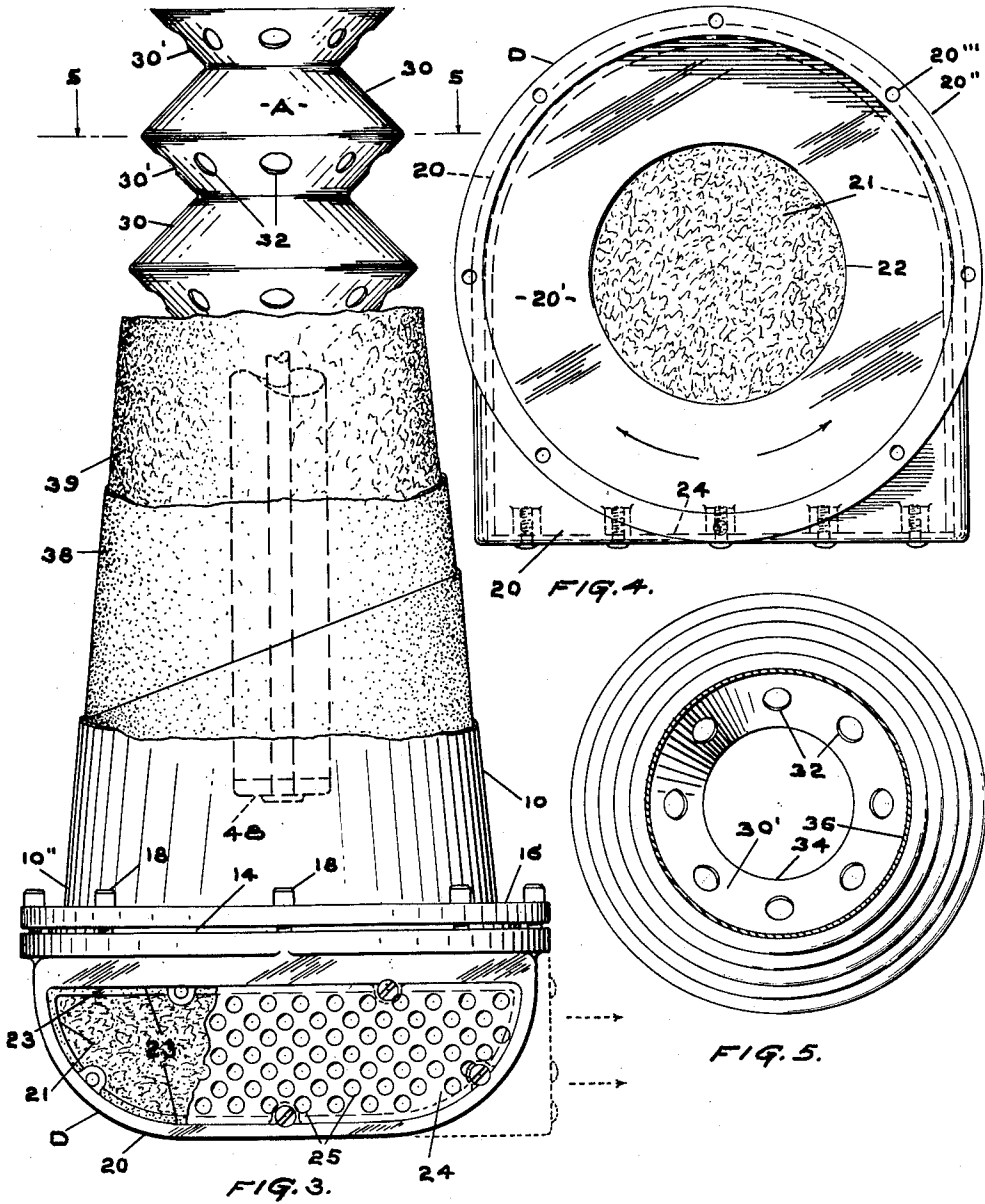
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3 Sheets-Sheet 2



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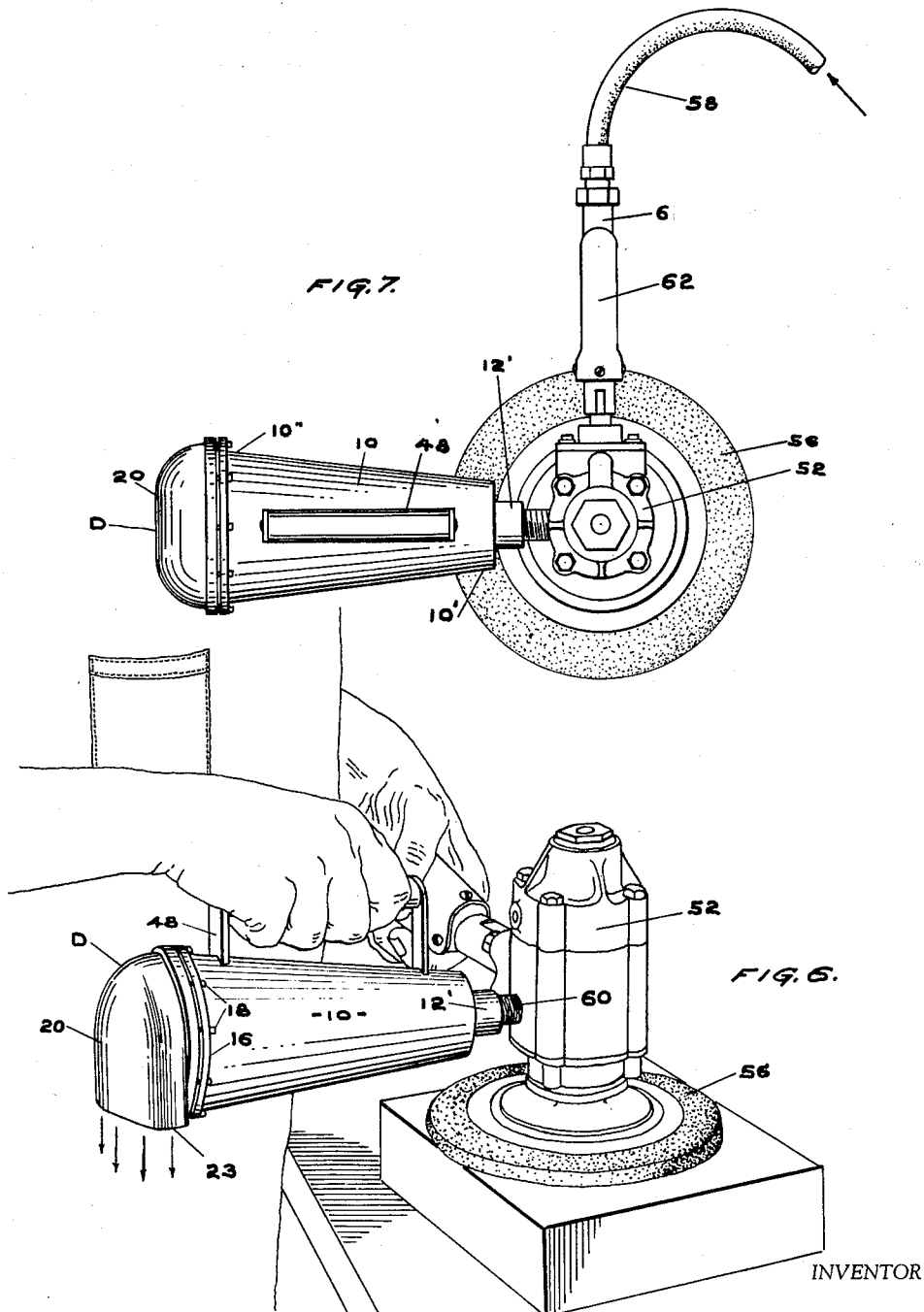
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3 Sheets-Sheet 3



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SILENCER

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3 Claims. (Cl. 181-50)

The present invention relates to silencers for fluid exhausts whether they are of either pulsating or continuous flow. The silencer is constructed primarily for portable pneumatic-driven apparatus, such as grinders, sanders, hammers, and the like. However, it may be employed in any type of exhaust where a silencer would be required or preferred whether portable or stationary.

One object of the invention is to provide a silencer that is compact and efficient and one that will reduce the high compression gas to substantially atmospheric pressure.

Another object of the invention is to provide a disposable and sound absorbing element which may be easily and quickly changed.

A further object is to provide an adjustable and removable air diffuser for the silencer which will further diffuse the exhausted gases as they are passed from the silencer and which may be utilized to hold the sound absorbing and dissipating element in place in the silencer.

A still further object of the invention is to provide means whereby the sound absorbing and dissipating element is surrounded by a resilient cushion for allowing slight movement thereof longitudinally and relative to the outside housing of the silencer.

While several objects and uses of the invention have been set forth, it is not intended that they be conclusive, as other objects and uses may become apparent to those skilled in the art as its nature is more fully disclosed.

The invention consists in its novel construction, combination and the arrangement of its several parts, all of which are illustrated in the accompanying drawings and described in the description to follow.

Figure 1 is a sectional view of the silencer.

Figure 2 is an elevational view of the replaceable sound absorbing unit carried by the silencer.

Figure 3 is a view of the silencer similar to that shown in Figure 1 partly in elevation, the outer portion being broken away in order to disclose the sound absorbing and dissipating unit.

Figure 4 is a separate detailed view somewhat in plan of the sound diffuser identified with the invention.

Figure 5 is a sectional view taken along the line 5-5 of Figure 3.

Figure 6 is a view in perspective showing the silencer in use with a pneumatic grinder.

Figure 7 is a top plan view of the same.

In referring to the drawings like numerals are used to point out like and similar parts throughout the several views.

Preferably, the silencer has a tapered or cone-shaped outer rigid hollow housing 10. This housing 10 is shown as being generally of cylindrical form in cross-section, but it may have any desirable conventional cross-sectional shape, such as square, rectangular, etc. Also, the housing may increase its diameter in steps rather than being tapered, if desired.

The small end 10' of the housing 10 is provided with an air intake opening 12 adapted to engage the exhaust

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end of the apparatus or for connecting it with an exhaust conduit. One means for accomplishing this is by a threaded coupling 12'. The larger end 10'' of the housing 10 is provided with an opening 19 having a diameter at least twice the size of the air intake opening 12 on the opposite end of the housing just described. Surrounding the outer edge of the larger end 10'' is a fixed ring 14. Over the larger end 10'' of the housing 10 and the fixed ring 14 is a sound diffuser "D" which is provided with an outer casing 20 having an inner side 20' adapted to be secured to the housing. The side is further provided with a circumferential flanged portion 20'' adapted to slidably fit over the ring 14. On the side 20' of the diffuser casing 20 there is an opening 22 at least as large as the opening 19 leading from the larger end 10'' of the housing. In the portion 20'' is a plurality of threaded holes 20''' so spaced about its circumference as to threadably receive screws 18. Adapted to slidably engage the inner surface of the ring 14 is a second ring 16. The ring 16 is provided with a number of spaced apertures adapted to slidably receive screws 18 which are also opposite the threaded holes 20'''. By this arrangement the diffuser 20 may be adjusted about the axis of the housing and fixed in any desired position by tightening down on the screws 18, or the degree of tightness of the screws may be sufficient to enable the turning of the diffuser to any desired position and maintained in said position without additional tightening of the screws. The diffuser is provided with an opening 23 which is at ninety degrees with the opening 22. The area of the opening 23 is at least as large as the opening 22.

Over the outer opening of the diffuser 20 is a perforated plate 24. The perforations are in the form of openings 25. The total area of the opening 25 is also at least as great as the area of the openings 19 and 22 in the larger end 10'' of the housing 10.

In the operation of most apparatus by compressed air, there are always small amounts of oil, dirt and the like being discharged, and the ordinary silencer soon becomes clogged with this oil, dirt, etc., which is prone to get on the operator, or the work, or both, and it is the purpose of the present invention to correct this particular fault and to construct a better silencer in general.

On the interior of the silencer there is provided a disposable sound absorbing unit which comprises generally an elongated member A having a side wall in the form of a bellows, which will be referred to hereafter as the sound-absorbing and dissipating element. This element A extends from the end 10' of the housing to the opposite end 10'' of the housing 10. The bellows-shaped wall is provided with portions 30 and 30' which are angularly disposed to each other, the angles of the portions 30 and 30' of the side walls being in separate planes substantially at right angles to each other and are joined along both their respective inner and outer edges. The wall sections 30' are angled to face towards the inlet end of the silencer and are provided with a plurality of openings 32. The inner wall surface of the member A consists of a plurality of hills 34 and valleys 36 sloping from the outer perimeter angularly toward the inner apex centerwise. On the outside of the side walls and within the recesses opposite the inner hills 34 there is provided a relatively loosely packed mass of glass fibers 39, usually referred to as "fiber glass," or other suitable and available interstitial material, which extends outwardly to a line drawn between the lower points of the inner valleys 36. About the glass fibers 39 there is a felt wrapping 38, or other suitable fibrous non-sound conducting material.

The elements A, 38 and 39 go to make up the sound-absorbing and dissipating insert unit. The sound-

absorbing element A may be secured to each end of the covering 38 for keeping the element in full extended position, the small end of the element A being secured to the covering 38 at 42, and the larger end being secured to the cover 38 at 44. This sound-absorbing and dissipating disposable element is adapted to be inserted within the larger end of the housing 10 and to fit snugly therein, and is held in place positionally by any conventional means or lack of displacement space. In the present disclosure the sound-absorbing unit is shown held within the housing by the gas-diffusing member 20 which has hereinbefore been described as adjustably secured to the larger end of the silencer.

Within the diffuser D there is provided an inner covering 21 of a material having a minimum amount of sound transmitting qualities, such as fiber glass, papier-mache, felt, or other interstitial material.

The bellows-shaped sound-absorbing and dissipating element A, with its angled side portions 30 and 30', extends the full length of the silencer housing 10. The member A is tapered outwardly in the same proportions as the housing 10 as it approaches the outlet end of the housing. The member A is formed of a non-sound transmitting material and is preferably molded from papier-mache, plastic, or similar interstitial material.

The air inlet 12 to the housing, as stated before, is preferably of substantially at least one-half the diameter of the outlet opening 19 in the housing. It will be noted that the sound-absorbing element A is of a structure that has a plurality of connecting sound receptacles in which the wall portions 30 and 30' meet each other at right angles. This type structure also lends itself to a slight oscillation lengthwise of its long axis of the housing particularly when its opposite ends are held substantially at fixed points. The openings 32 in the wall portion 30' also act to allow the air pressure to be evenly distributed on the inner and outer surfaces of the wall sections 30 and 30' to prevent collapse and distortion of the walls.

In using the silencer with some types of tools, or apparatus, a handle 43 is provided to aid in manipulating and balancing the tool. However, the housing 10 may very well be used for a handle itself.

The silencer is illustrated in use with a grinding tool as shown in Figures 7 and 8. These grinding tools comprise generally a rotatable arbor (not shown) carried within a casing 52 on which is secured a grinding wheel 56. Compressed air is led into the casing by the flexible conduit 53 and exhausted through an opening 60 which is connected with the threaded connector 12' of the silencer. The flexible conduit 53 is in turn secured to a rigid conduit 61. Associated with this rigid portion 61 is an air valve control lever 62. This rigid conduit 61 serves as a guiding and manipulating handle for the apparatus.

In operation, compressed air is fed into the casing 52 which rotates the arbor and the grinding wheel 56 by the principle of turbine propelled fins (not shown). The air is exhausted out of the opening 60 into the small inlet 12 at the small end of the silencer. As the air moves through the silencer, it expands contacting with force the sides 30' of the member A in particular, which is angled toward the on-coming air. Part of the air and sound passes through the openings 32 into the fiber glass 39 and is cushioned thereby which also builds up a pressure on the outside of the wall portions 30 and 30'. The sound contacting the surfaces 39 and 30' is rebounded at right angles to each other, and, therefore, the sound is disrupted and silenced by the principle of losing sound value by changing the sound wave direction. The member A, beginning at its smaller end, gradually increases in cross-sectional area toward the larger end of the housing and the outlet end of the silencer which, in turn, increases the size of the connected sound receptacles. This allows the compressed air to expand progressively and to return quite

nearly to normal atmospheric pressure, and to a large extent dissipate the sound.

When the air and sound enter the air diffuser 20, the direction of the sound and air are again changed at an angle of approximately 90 degrees, which change in direction further dissipates the sound. The sound is still further reduced by passing the exhaust air from the diffuser outwardly through the plurality of openings 25 at the outer end of the diffuser.

The silencer is not only adapted to use on such apparatus as shown in Figures 7 and 8, but may be used in many other types of tools or apparatus such as previously referred to, and in other instances too numerous to mention.

The location of the silencer on the apparatus is important. It is located at a point not more than 90 degrees from the air intake and handle member in order to provide a second handle at a convenient location and to make the apparatus the more maneuverable and available to work into close places particularly in corners of various structures. The position of the diffuser is adjustable to direct the exhaust gases toward the work, or the apparatus may be moved into such a position over the work as to remove or blow objectionable abrasives, grindings, etc. from the work surface.

While the invention has been illustrated and described in a particular form, it is not intended as a limitation and its scope is best defined in the appended claims which have been allowed in view of the prior art.

I claim:

1. A silencer for absorbing and dissipating the sound of high pressure exhaust gases from fluid actuated apparatus comprising, means for attaching the silencer to the said apparatus, the silencer having an outer elongated rigid continuous side wall and a gas inlet opening at one end for receiving the high pressure gases and a gas outlet opening in the opposite end of the housing from which the gases are exhausted from the silencer under low pressure to the atmosphere, the housing being of smaller diameter at the end of the housing adjacent the gas inlet opening and of larger diameter at the end adjacent the gas outlet opening, the housing increasing progressively in diameter from the end adjacent the inlet opening to the end adjacent the outlet opening for gradually increasing the cubic area of the housing to provide space for the expanding gases as their pressure is lowered, an elongated separate insertable disposable inner element of substantially the same length and adjacent the inside surface of the housing and form-fitting with respect to said housing surface, said insertable element having a continuous bellows shaped side wall in which half of the inner surfaces of the bellows wall are angled toward the gas inlet and the other half are angled toward the gas outlet providing a plurality of communicating sound receptacle therein, the diameter of the bellows insert increasing in diameter from the gas intake end of the silencer to the gas outlet end thereof, a resilient cushion surrounding the bellows wall element and means removably engageable with the exhaust end of the silencer housing for retaining the same within the housing.

2. A silencer for absorbing and dissipating the sound of high pressure exhaust gases from fluid actuated apparatus comprising, means for attaching the silencer to the said apparatus, the silencer having an outer elongated rigid continuous side wall and a gas inlet opening at one end for receiving the high pressure gases and a gas outlet opening in the opposite end of the housing from which the gases are exhausted from the silencer under low pressure to the atmosphere, the housing being of smaller diameter at the end of the housing adjacent the gas inlet opening and of larger diameter at the end adjacent the gas outlet opening, the housing increasing progressively in diameter from the end adjacent the inlet opening to the end adjacent the outlet opening for gradually increasing the cubic area of the housing to provide space for the ex-

panding gases as their pressure is lowered, an inner element within the housing having a central passage increasing in diameter in the same ratio as the outer housing extending therethrough, the walls of the inner element having a plurality of rigid angled surfaces positioned substantially at right angles to each other extending about the inner element and increasing in area progressively from the small to the large diameter of the element for engaging part of the gas stream passing through the central opening for changing the direction of that part of the gas stream and directing the same back into the remaining portion of the gas stream passing through the central opening, a low sound conducting wrapping extending about the inner element adapted to fit into the said outer housing, a gas diffuser fitted to the large exhaust end of the housing having an inlet at least equal in size to the gas outlet of the inner element and an outlet in the form of a plurality of small openings of which their total areas are at least equal to the area of the diffuser intake opening .

3. In a device as claimed in claim 2 in which the sound absorbing element is provided with a plurality of openings on the surfaces of the bellows element angled to-

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ward the gas inlet opening for admitting air and sound waves beyond the bellows surfaces for equalizing the pressure on each side of the bellows surface to prevent its collapsing under the high pressure of the exhaust gases.

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