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SILENCER WITH FREELY MOVABLE, LIMP DIAPHRAGM

Filed Feb. 12, 1964

2 Sheets-Sheet 1

Fig. 1.

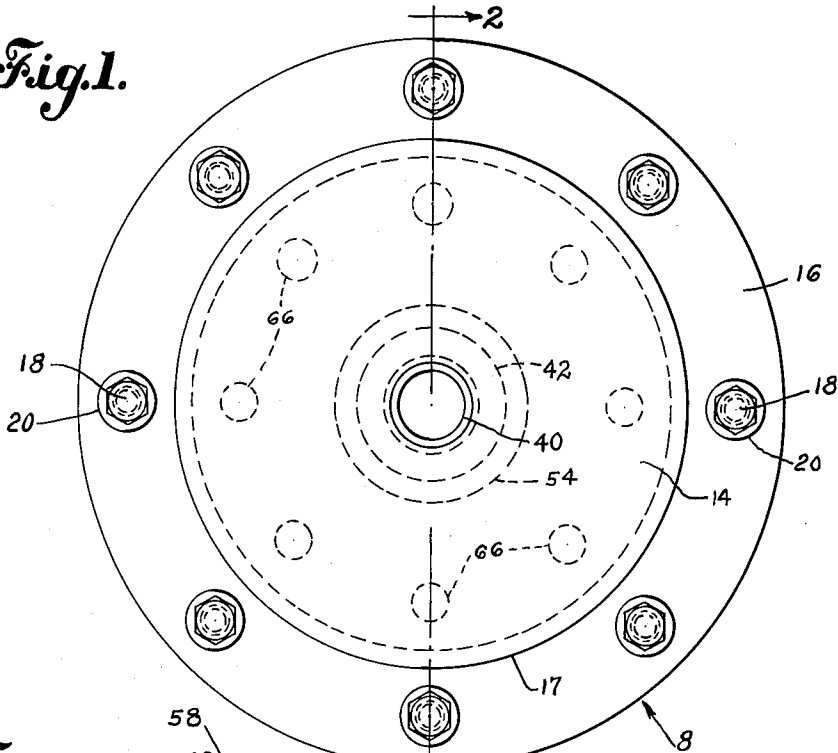
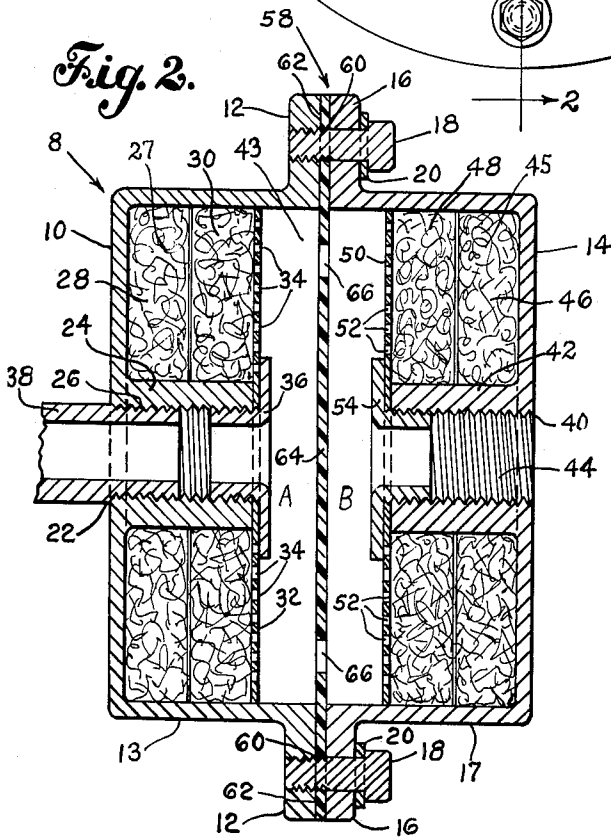


Fig. 2.



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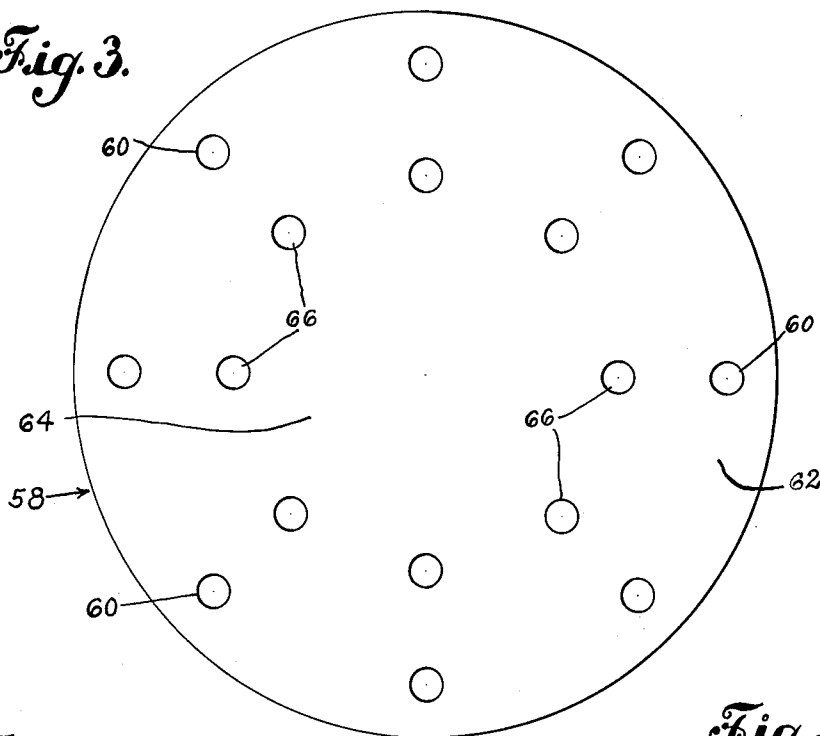
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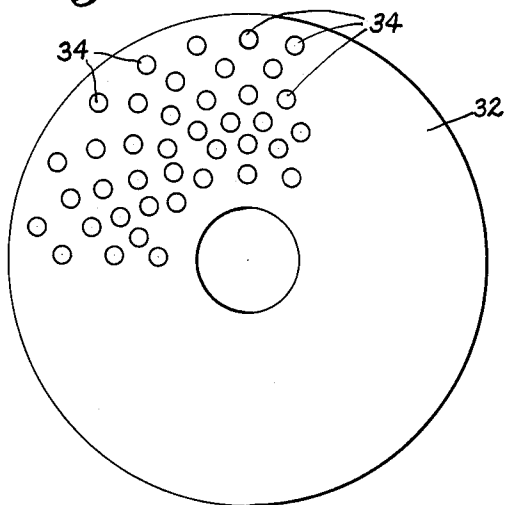
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2 Sheets-Sheet 2

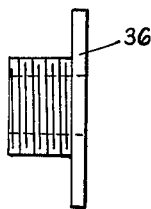
*Fig. 3.*



*Fig. 4.*



*Fig. 5.*



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3,209,857  
**SILENCER WITH FREELY MOVABLE  
 LIMP DIAPHRAGM**

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 Filed Feb. 12, 1964, Ser. No. 344,264  
 5 Claims. (Cl. 181—50)

This invention relates to a muffler or silencer to reduce noise, especially from engines, compressors and pneumatic equipment.

One object of my invention is to provide a portable silencer of simplified construction that can be connected to apparatus, such as an air compressor intake, for instance, and materially reduce the noise caused by its operation without impeding the flow of air.

Another object is to make such a silencer that is compact, yet effective, by using a diaphragm of impervious material with perforations, located between two chambers and that obstructs the direct passage of sound but does not impede the flow of air.

Still another object is to provide a diaphragm under some circumstances, that is limp, so that it is free to move in the direction of reduced pressure to thereby minimize pulsations.

A further object is to so construct said silencer that it is relatively simple and economical to manufacture, and formed of parts that can be assembled and disassembled quickly and easily.

The foregoing and other objects which will appear as the nature of the invention is better understood, may be accomplished by a construction, combination and arrangement of parts such as is disclosed by the drawings. The nature of the invention is such as to render it susceptible to various changes and modifications, and therefore, I am not to be limited to the construction disclosed by the drawings nor to the particular parts described in the specifications; but am entitled to all such changes therefrom as fall within the scope of my claims.

In the drawings:

FIG. 1 is a front elevational view of my silencer.

FIG. 2 is a sectional view taken on the line 2—2 of FIG. 1.

FIG. 3 is a plan view of a diaphragm used in my silencer.

FIG. 4 is a plan view of a cover used in front of sound absorbing material to hold it in place.

FIG. 5 is a side elevational view of a retainer to hold said cover in place.

As illustrated, I provide a housing or casing 8 embodying a section or end portion 10 at one end with an outer flange or rim 12 at a side 13 and another section or end portion 14 at an opposite end with an outer flange or rim 16 at a side 17 thereof. Cap screws 18, used with washers 20, hold said sections 10 and 14 together at their flanges.

A passage 22 is provided in said section 10 where a sleeve portion or conduit 24 is formed that extends inwardly and is interiorly screw-threaded as at 26. Between said sleeve portion 24 and said casing side 13 a space 27 is provided that may be used to receive sound absorbing material which I show in the form of an outer layer 28 and an inner layer 30. The outer layer 28 is preferably somewhat denser than the inner layer 30.

A cover 32 which may be of sheet metal such as aluminum, having perforations 34, covers the entrance to said space 27, and a screw-threaded, hollow retainer 36 enters said passage 22 and screw-threadedly connects with said screw-threads 26 and retains said cover 32 in place. A conduit 38 is shown entering said passage 22 and screw-threadedly connecting with said threads 26, which conduit

may connect with an air compressor or other sound producing device, for instance.

Said sections 10 and 14 are spaced apart as at 43, and the space is divided as later explained.

In said other section 14 a passage 40 is provided where a conduit or sleeve portion 42 is connected that is interiorly screw-threaded as at 44. Between said sleeve portion 42 and said casing side 17 a space 45 is provided that may be used to receive sound absorbing material shown in the form of an outer layer 46 and an inner layer 48, similar to said layers 28 and 30. Said layers 28, 30, 46 and 48 may be made of fiber glass or other sound absorbing material. The latter material may be omitted, or used in only one of said spaces 27 and 45, and yet good results attained.

A cover 50, similar to cover 32, having perforations 52 covers the entrance to said space 45 and a hollow retainer 54 enters said passage 40 and screw-threadedly connects with said screw-threads 44 and retains said cover 50 in place.

In said space 43 at an intermediate location thereof is a diaphragm sheet 58 of high density and substantially non-porous material such as rubber, plastic or a metal, and which divides said space 43 into two chambers A and B. This diaphragm has holes 60 in an outer or attaching portion 62 near the periphery through which said screws 18 pass to firmly hold said diaphragm 58 between said section flanges 12 and 16. The total area of said holes 66 is at least one and one-half times the area of either of said passages 22 or 40. Inwardly of said outer portion is an inner portion 64. Said diaphragm may be relatively thin, such as 1/16 inch thick, for instance.

Spaced outwardly from the center of said diaphragm 58 and inwardly from said holes 60 are holes 66 in said inner portion 64 providing an indirect passage for air between the two chambers of space 43.

Said escape holes 66 are shown in a concentric circle spaced apart for a greater distance than the diameter of each hole, although the particular positions of these escape holes and their distance apart may be varied a great deal. The total area of said holes 66 is greater than the open area of a said passage 22 or 40 to avoid excessive pressure drop through these holes. For instance, there may be eight escape holes 66 of 1/4 inch diameter and a passage 22 or 40 may have a diameter of 1/2 inch. These holes 66 are shown in the peripheral outer half of said diaphragm inner portion 64 and may be in the outer peripheral quarter portion thereof as shown in said FIG. 2, for instance.

In said FIG. 2 said conduit 38 may communicate with an air compressor intake, for instance, in which event air may enter said passage 40 and pass out the opposite passage as into an air compressor cylinder head not shown. In this case the sound flow will be counter to the air flow since the sound waves traveling through my silencer travel at a velocity many times that of the air flow. The sound waves will strike the diaphragm 64 and be deflected across the space in chamber A into the outer wall of said section 10 and into said insulation 28 and 30. Sound waves reflected from the latter outer wall may pass through said holes 66 into said chamber B and will be absorbed by insulation 46 and 48 or be deflected against the outer wall of said section 14 towards said diaphragm 64. Each time a sound wave is directed into the acoustical insulation or deflected from said outer wall it loses energy so that those waves that finally emerge through said passage 40 have given up much or all of their energy and hence the intensity of the noise that entered said passage 38 has been materially reduced or eliminated.

The effectiveness of this silencer depends upon the frequency of the sound waves and the size of the silencer.

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Low frequency sound waves have very long wave lengths and are difficult to attenuate, whereas high frequency sound waves have short wave lengths and are attenuated more easily.

Said diaphragm 64 may have a limp quality or be designed so that its natural vibration frequency is lower than the frequencies of the most intense sounds that require attenuation.

What I claim is:

1. A silencer for reducing noise at frequencies that require attenuation to reduce noise comprising a housing having opposite sections spaced apart providing a central space and each of which has a passage extending from outside and communicating with said central space, a sleeve portion in each said passage, one of said sections embodying a conduit portion at one end in a said passage and extending into the interior of said housing, said latter section having a side portion extending angularly from an end thereof and providing another space between said side portion and said sleeve portion adapted to receive sound absorbing material, a freely movable, limp diaphragm having a natural vibration frequency lower than said frequencies that require attenuation in said central space at an intermediate point thereof and embodying an outer attaching portion attached to said housing at an outer portion thereof and embodying an inner portion having a plurality of holes for the escape of air spaced outwardly from the center of said diaphragm and communicating with said central space.

2. A silencer for reducing noise at frequencies that require attenuation as set forth in claim 1 in which said other space has sound absorbing material therein extending from said side portion and surrounding said sleeve portion.

3. A silencer for reducing noise at frequencies that require attenuation as set forth in claim 2 in which said sound absorbing material has two layers one of which is of greater density than the other.

4. A silencer for reducing noise at frequencies that require attenuation comprising a housing having opposite sections spaced apart providing a central space and each

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of which has a passage extending from outside and communicating with said central space, a sleeve portion in each said passage, each of said sections embodying a conduit portion at one end in a said passage and extending into the interior of said housing, each of said sections having a side portion extending angularly from an end thereof and providing other spaces between each said side portion and each said sleeve portion adapted to receive sound absorbing material, a freely movable, limp diaphragm having a natural vibration frequency lower than said frequencies that require attenuation in said central space at an intermediate point thereof and embodying an outer attaching portion attached to said housing at an outer portion thereof and embodying an inner portion having a plurality of holes for the escape of air spaced outwardly from the center of said diaphragm and communicating with said central space.

5. A silencer for reducing noise at frequencies that require attenuation as set forth in claim 4 and sound absorbing material within each of said other spaces extending from said side portion and surrounding said sleeve portion, and a cover outside of each said other spaces having holes therein communicating with said central space.

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