Nov. 25, 1969 H. T. BURRIS 3,480,105

DEVICE FOR SILENCING GAS FLOW STREAMS

Filed Dec. 13, 1968 3 Sheets-Sheet 1

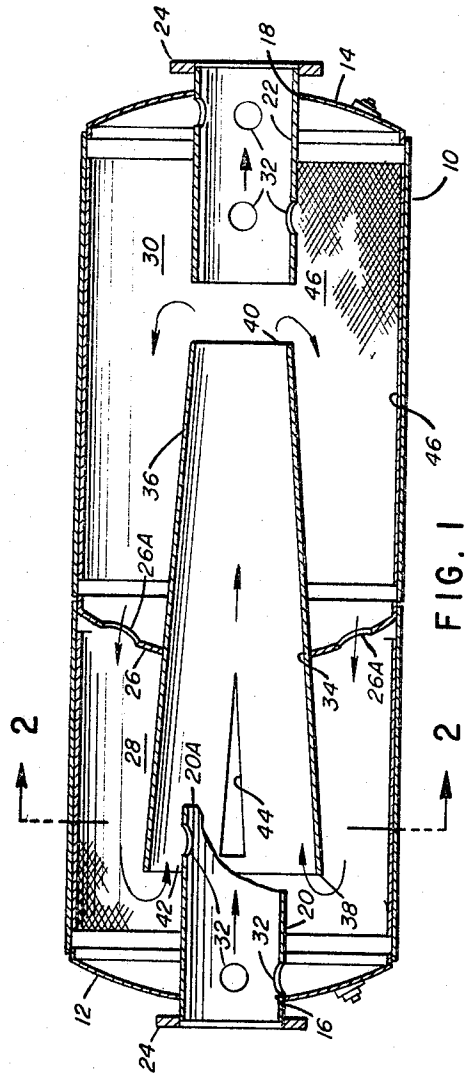


FIG. 1

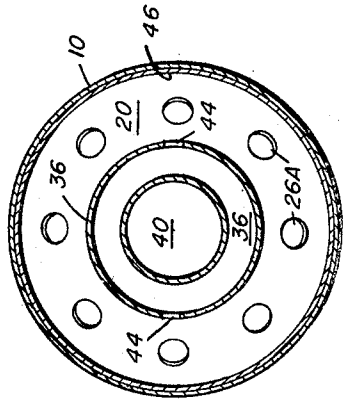


FIG. 2

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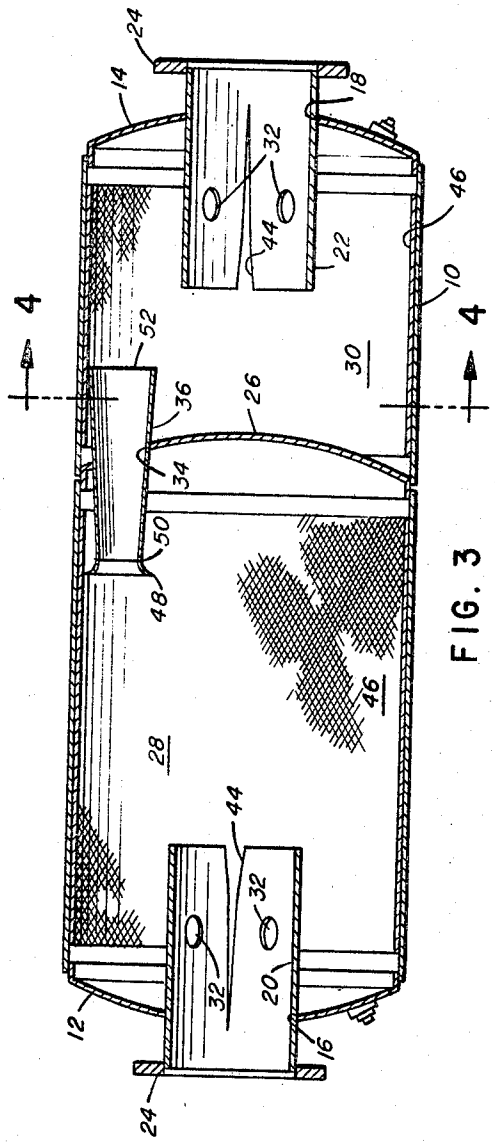


FIG. 3

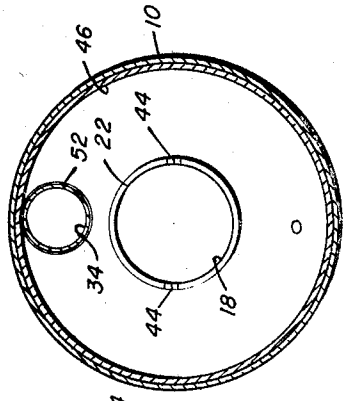


FIG. 4

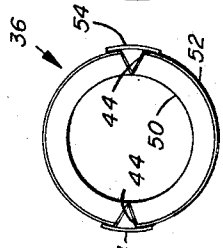


FIG. 6

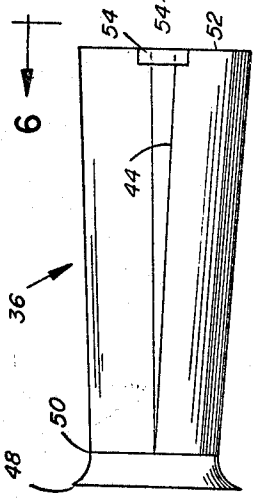


FIG. 5

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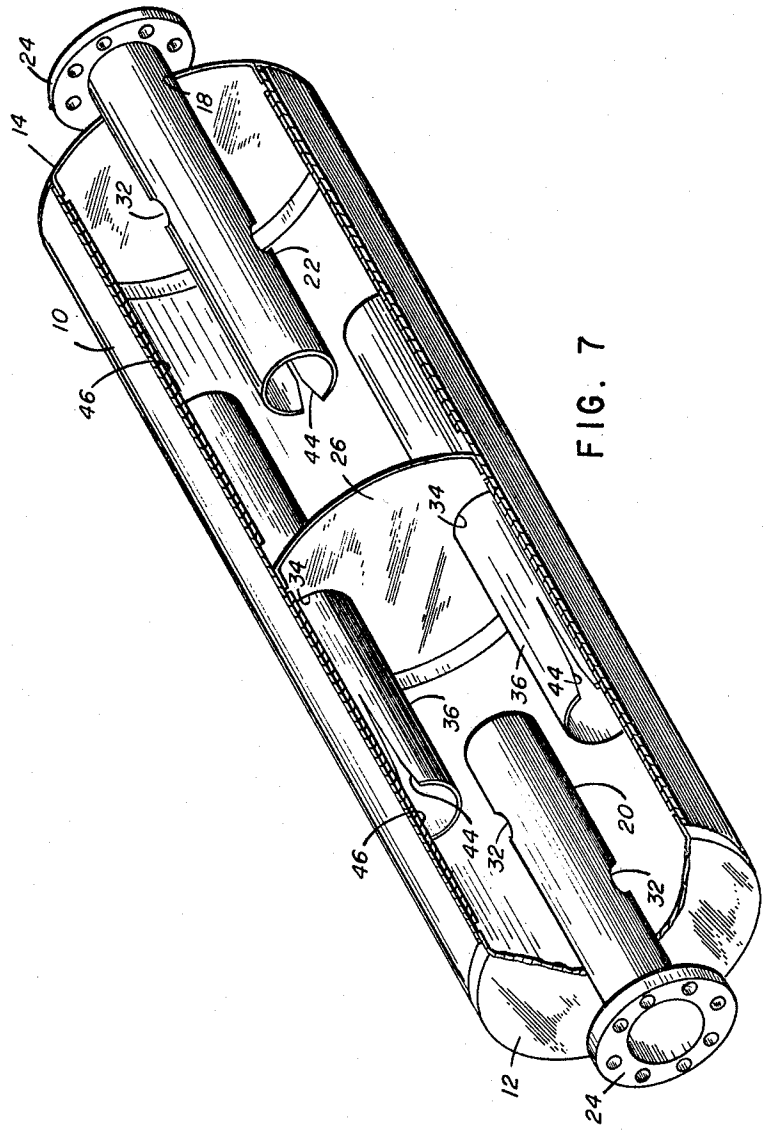


FIG. 7

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DEVICE FOR SILENCING GAS FLOW STREAMS

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Int. Cl. F01m 1/00
U.S. Cl. 181—47 8 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to devices for silencing gas flow. More particularly, the invention relates to devices for silencing gas flow including an elongated closed tubular shell, a partition wall dividing the interior of the shell into dissimilar volume chambers, an inlet conduit connecting to one of the chambers through one end of the shell and an outlet conduit connecting to the other chamber through the other end of the shell, each of the outlets having the plurality of spaced openings therein within the shell, and a baffle tube in the partition baffle communicating the inlet and outlet chamber with each other. In one embodiment the baffle tube is arranged to induce a circulation of return air flow within the silencer to further eliminate sound pulsations in the outlet gas flow.

Cross-reference

This disclosure is not related to any pending United States or foreign patent applications.

Background and summary of the invention

The requirement for silencers for gas flow is well known in industry. The typical requirement for silencers is on the exhaust of internal combustion engines. Other applications include rotary positive blower intake and discharges, reciprocating air compressor intakes, steam-jet ejector discharges, and low pressure atmospheric vents.

In most applications for silencing gas flow it is important that the silencer function in such a way as to achieve substantial reduction in pressure variations in the gas flow while at the same time imparting the minimum back pressure in the gas stream. In most applications the sound waves which produce noise in association with gas stream flows are highly complex and include both high and low frequency bands. Some, in attempting to eliminate the sound frequencies in given band ranges, have provided silencing devices designed to resonate at frequencies so as to cancel out specific bands of frequencies associated with specific noises. In some applications wherein the noise is characterized substantially by precisely determined frequencies such resonating type silencers function satisfactorily but in the majority of cases the sounds are so complex that resonating type silencers are only partially successful, or if successful, serve to eliminate only portions of the bands of sounds associated with the gas stream.

This invention pertains to silencing devices of the nonresonating type and therefore of the type adaptable to silence sounds over a wide frequency band range.

It is therefore an object of this invention to provide an improved device for silencing gas flow.

More particularly, an object of this invention is to provide devices for silencing gas flow characterized by improved efficiency and effectiveness in an arrangement inducing minimum flow restriction to the gas stream.

Another object particularly relating to a specific embodiment of the invention includes the arrangement of inducing secondary flow between separate chambers in a silencing device for reducing the sound level at the gas stream outlet.

These and other objects will be understood with reference to the following description and claims taken in conjunction with the drawings.

Description of the views

FIGURE 1 is a cross-sectional view of one embodiment of a gas silencer device of this invention showing the arrangement wherein secondary air flow is caused to exist between an inlet and an outlet chamber to reduce the sound level of the gas outlet stream.

FIGURE 2 is a cross-sectional view taken along the line 2—2 of FIGURE 1.

FIGURE 3 is a cross-sectional view of an alternate embodiment of the invention.

FIGURE 4 is a cross-sectional view taken along the line 4—4 of FIGURE 3.

FIGURE 5 is an external view of one of the venturi configured baffle tubes that is utilized in the embodiment of FIGURE 3.

FIGURE 6 is an end view as taken along the line 6—6 of FIGURE 5 of the venturi configured baffle tube.

FIGURE 7 is an isometric view of a device for silencing gas flow according to this invention shown partially cut away, and showing still another alternate embodiment of the invention.

Detailed description

Referring now to the drawings and first to FIGURES 1 and 2, one embodiment of the invention is illustrated. The silencing device of this invention includes basically an elongated tubular shell 10 which is typically formed of rolled sheet steel. Closing the shell is an inlet end plate 12 and an outlet end plate 14. Inlet end plate 12 includes an inlet opening 16 and in like manner, outlet plate 14 includes an outlet opening 18. Positioned within inlet opening 16 and coaxial of the tubular shell 10 is an inlet conduit 20 and similarly, in outlet opening 18 is a coaxial outlet conduit 22. Each of the conduits 20 and 22 may include a flange 24 as illustrated as a means whereby the silencing device may be attached to piping used to carry the gas stream into and out of the device.

Intermediate the end plates 12 and 14 is a partition baffle 26 which divides the interior of the tubular shell into an inlet chamber 28 and an outlet chamber 30. Thus inlet conduit 20 communicates with inlet chamber 28 and outlet conduit 18 with outlet chamber 30.

Both the inlet conduit 20 and outlet conduit 22 includes a plurality of spaced apart openings 32. Openings 32 in inlet conduit 20 permit gas passing into the silencer to pass partially out through such openings and partially out the end of the tube. In the same manner gas passing out of the silencer from outlet chamber 30 passes partially out through the end of the outlet conduit 18 and partially out through openings 32. Openings 32 tend to equalize pressure levels of gas interiorly and exteriorly of the conduits and thereby assist in reducing the ratio of high to low pressures associated with sound waves in the gas medium.

Partition baffle 26 includes an opening 34 in which is positioned a baffle tube 36. The baffle tube 36 of FIGURE 1 is frusto-conical in configuration and tapers from a large diameter end 38 positioned within inlet chamber 28 to a small diameter end 40 positioned in chamber 30.

Inlet conduit 20 extends coaxially and telescopically within the large diameter end 38 of baffle tube 36 and is of diameter less than the large diameter end of the baffle tube providing a secondary air flow annulus 42.

In the preferred embodiment the baffle plate 26 is so positioned that the volume of inlet chamber 28 and outlet chamber 30 is dissimilar, that is, the volume of one chamber it as variance with that of the other. Whether

the outlet chamber **30** is larger in volume than the inlet chamber **28**, as illustrated in FIGURE 1, or the reverse is the arrangement, is not significant as long as the volume of the two chambers is dissimilar. It has been learned that by providing dissimilar volumes the opportunity of establishing resonance between the two volumes is greatly reduced and thereby the effectiveness of the silencer is improved.

Gas flows into the silencer through inlet conduit **20**. By the arrangements of FIGURE 1 a jet effect is achieved between the inlet conduit **20** and the baffle tube **36** causing the pressure in the outlet chamber **30** to be greater than that in the inlet chamber **28**. It can be seen that the openings **32** must not be too large in total area compared to the opened end **28** of the outlet conduit **20** in order to achieve the jet effect. By proper engineering the openings **32** can be made to have a total area as large as possible while still maintaining a jet arrangement wherein the pressure in outlet chamber **30** is greater than that in inlet chamber **28**.

With the pressure in the outlet chamber **30** exceeding the pressure in inlet chamber **28** gas is caused to flow through openings **26A** in baffle **26** from the outlet chamber into the inlet chamber, as illustrated by the arrows. Gas is drawn from the inlet chamber **28** into the annular area **42** and passed through the interior of the baffle tube **36** and out through end **40** into the outlet chamber **30**. Thus, a recirculation of secondary gas flow is caused within the silencer. Such recirculation has an important effect in substantially reducing the maintenance of pressure variations in the gas medium and thus results in substantial reduction of sound waves.

To further increase the effectiveness of the silencer of the arrangement of FIGURE 1 tapered slots **44** may be provided, as shown, in the baffle tube **36**. The utilization of such tapered slots provides an arrangement wherein a part of the vibration carried by gas passing through the tube **36** passes immediately through the wide portion of the slot **44** into the inlet chamber **28** while other portions of such vibrations or pressure waves are carried to the small end of the slot **44**. This further tends to break up the sound vibrations carried by the gas stream passing through the silencer.

Positioned within the interior of tubular shell **10** in both the inlet and outlet chambers is a dampening layer formed of expanding metal. The expanded metal **46** covers a substantial portion of the interior cylindrical surface of both the inlet and the outlet chambers. Such metal adds strength and rigidity to the overall structure, however, its most important function is that it serves as a deadening layer helping to absorb sound waves which tend to pass directly through the shell.

Referring now to FIGURES 3, 4, 5, and 6, an alternate embodiment of the invention is shown. In this arrangement the baffle tube **36** is of a venturi configuration. That is, it includes a forward flared end **48** positioned in the inlet chamber **28**, a constricted middle portion **50** and a rearward flared end **52** positioned in outlet chamber **30**. Passage of gas through venturi configured baffle tube **36** results in changes in the pressure and flow rate of the gas as it passes through the venturi according to the well known venturi principle. Such pressure changes materially break up sound waves in the gas stream. While only one of the venturi configured baffle tubes **36** is shown in FIGURES 3 and 4, as many as required may be provided. In the usual application a plurality of such venturi configured baffle tubes will be utilized.

In the arrangement of FIGURE 3, the inlet conduit **20** and outlet conduit **22** is each provided with tapered slots **44**. Such slots **44** provide gradually changing pressure relationships of gas passing through the conduits **20** and **22** to break up sound waves as previously described relative to slot **44** in the baffle tube of FIGURE 1.

FIGURES 5 and 6 show the arrangement of construction of a venturi configured baffle tube in which the baffle tube itself is likewise provided with a tapered slot **44**. The tapered slot begins with the constricted middle portion **50** and tapers in increased divergence to a maximum at the rearward flared end **52**. To add rigidity to the venturi configured baffle tube metal tabs **54** may be spot welded across the end of slots **44** as shown best in FIGURE 6.

FIGURE 7 shows still another alternate embodiment of the invention in which the baffle tubes are each cylindrical in configuration. In the arrangement of FIGURE 7 the inlet tube **20** and outlet conduit **22** each preferably extends in overlapping relationship with the ends of the baffle tubes **36**. In addition, baffle tubes **36** are provided with tapered slots **44** which serve the same function as previously described. The effect of the tapered slots **44** in baffle tubes **36** is particularly augmented when combined with the tapered slots **44** in inlet and outlet tubes **20** and **22** to break up sound waves in the gas stream.

It can be seen that in each of the embodiments of the invention illustrated, the silencer is characterized by extreme simplicity and economy of construction in an arrangement imposing very little restriction to the flow of gas. Thus, the silencer of this invention produces a minimum of back pressure on the gas stream being silenced.

While the invention has been described with a certain degree of particularity it is manifest that many changes may be made in the details of construction and the arrangement of components without departing from the spirit and scope of this disclosure. It is understood that the invention is not to be limited to the abstract herein, nor the embodiments which have been presented to exemplify specific arrangements of the invention.

What is claimed is:

1. A device for silencing gas flow streams comprising:
- an elongated closed tubular shell having an opening in each end thereof;
- a partition baffle dividing the interior of the shell into an inlet chamber and an outlet chamber, said partition baffle having at least one opening therein;
- a tubular inlet conduit communicating with said opening in one end of said shell, said inlet conduit being of reduced diameter compared with said shell and extending coaxially in the interior of said inlet chamber and having a length less than the axial length of said inlet chamber, said inlet conduit having a plurality of spaced apart openings therein diametric of the tubular axis;
- a tubular outlet conduit communicating with said opening in the opposite end of said shell, said outlet conduit being of reduced diameter compared with said shell and extending coaxially in the interior of said outlet chamber and having a length less than the axial length of said outlet chamber, said outlet conduit having a plurality of spaced apart openings therein diametric to the tubular axis; and
- a baffle tube positioned in said opening in said partition baffle and extending partially within each of said inlet and outlet chambers.

2. A device for silencing gas flow according to claim **1** wherein said partition baffle is positioned nearer one end of said tubular shell than the other whereby said inlet and outlet chambers are of different volumes.

3. A device for silencing gas flow according to claim **1** wherein said openings in said inlet conduit and said outlet conduit are each in the form of elongated tapered slots each of said slots being widest near the end of the conduit and tapering to a point of convergence adjacent the shell end.

4. A device for silencing gas flow according to claim **1** wherein said baffle tube has an internal cross-sectional configuration defining a venturi having flared ends and connected by a constricted middle portion.

5. A device for silencing gas flow according to claim **1** including a layer of expanded metal covering a substan-

tial portion of the interior cylindrical surface of said inlet and outlet chambers.

6. A device for silencing gas flow according to claim 1 wherein said baffle tube includes a truncated conical shaped tube coaxially positioned within said shell having the larger diameter end in said inlet chamber and the smaller diameter end in said outlet chamber, said inlet conduit extending into said baffle tube and providing an annular opening between the exterior of said inlet conduit and the interior of said baffle tube, and said partition baffle having spaced apart secondary air flow openings therein between the exterior of said baffle tube and the interior of said shell.

7. A device for silencing gas according to claim 6 wherein said baffle tube has at least one tapered slot therein communicating the interior of the baffle tube with said inlet chamber.

8. A device for silencing gas according to claim 1 wherein said baffle tube is tubular and includes at least one tapered slot, said slot tapering from adjacent the end of said baffle tube extending within said inlet chamber and converging at a point adjacent said partition baffle.

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U.S. Cl. X.R.

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