

**Oct. 21, 1958**

**R. B. BOURNE**  
SILENCER FOR POSITIVE PRESSURE GAS STREAMS  
SUBJECTED TO HIGH AMPLITUDE PULSATONS  
Filed Nov. 1, 1956

**2,857,014**

FIG. 1.

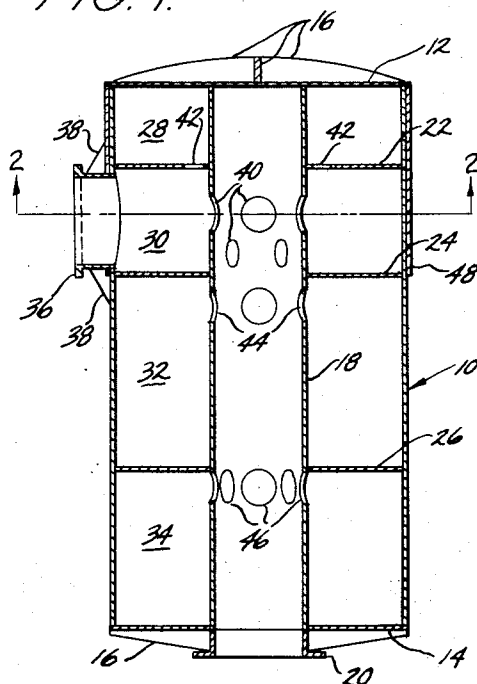
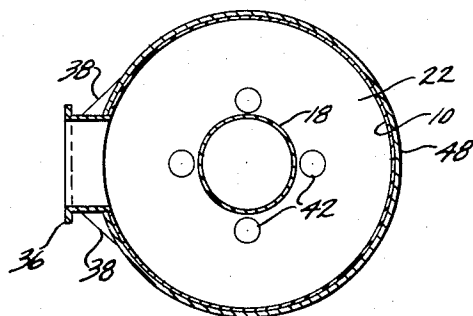


FIG. 2



INVENTOR.  
ROLAND B. BOURNE  
BY  
Teller & McCormick  
ATTORNEYS

1

2,857,014

## SILENCER FOR POSITIVE PRESSURE GAS STREAMS SUBJECTED TO HIGH AMPLITUDE PULSATIONS

Roland B. Bourne, West Hartford, Conn., assignor to The Maxim Silencer Company, Hartford, Conn., a corporation of Connecticut

Application November 1, 1956, Serial No. 619,799

6 Claims. (Cl. 181-59)

This invention relates to an improved silencer for use in installations wherein there is an air or gas stream under positive pressure and subjected to high amplitude pulsations at a relatively low frequency. A positive pressure blower assembly is one example of an installation where low frequency, high amplitude pulsations occur in an air stream and wherein the pulsations are of such magnitude that mechanical failure or destruction may occur if an ordinary silencer is employed. While the discharge pressure of such a blower may be only a few pounds per square inch, the amplitude and frequency of the pulsations in the air stream, especially when acoustic and mechanical resonances are encountered, can be expected to cause fatigue failure in the ordinary silencer and/or in the piping or other apparatus associated therewith.

It is the general object of the invention to provide a silencer which is adapted for high acoustic attenuation so as to reduce the amplitude of the pulsations in installations of the aforementioned type and which is of such mechanical construction as to withstand the stress encountered in such installations.

Other, more specific objects of the invention, as well as its features, will become apparent to those skilled in the art from the following description having reference to the attached drawing wherein, by way of preferred example only, one specific embodiment of the invention is shown and wherein,

Fig. 1 is a longitudinal cross-sectional view of a silencer constructed in accordance with the present invention; and Fig. 2 is a transverse cross-sectional view of the silencer taken as indicated by the line 2-2 of Fig. 1.

In preferred form, a silencer constructed in accordance with this invention comprises a generally cylindrical sheet metal shell 10 which is closed at one end by a transverse header 12 and at the other end by a generally similar header 14. While the end headers 12 and 14 have been shown at comprising flat plates, it will be understood that these headers can be curved in the interests of providing greater mechanical strength to the construction. However, flat plate end headers of the type shown may be used and re-enforced by a plurality of radially extending gussets 16, 16.

The end headers 12 and 14 are further re-enforced and held rigid by a longitudinally extending conduit 18 which is preferably located with its longitudinal axis on the longitudinal center line of the shell 10. The conduit 18 is provided to define the main gas and sound conducting channel within the silencer, and the said conduit is welded or otherwise rigidly secured to one end header 12, which for convenience will hereinafter be referred to as the top end header, and it is also welded or otherwise rigidly secured in a central opening defined in the other end header 14. Thus, the top end header 12 closes one end of the conduit 18 and the bottom end header 14 embraces the other end of the conduit. The said other end of the conduit is open and in communication with an outlet fitting 20

2

which is secured to the bottom end header and which is adapted for connection to a pipe or the like.

The silencer construction is made more rigid or re-enforced by a plurality of transverse partitions 22, 24, and 26 each of which comprises a sheet metal plate which is welded at its periphery to the generally cylindrical shell 10 and which is also welded to the conduit 18 at a central opening receiving the said conduit. The interior partitions 22, 24 and 26 are spaced along the conduit 18 and shell 10 to define annular chambers 28, 30, 32 and 34, the chamber 28 being defined between the header 12 and the partition 22, the chamber 30 being defined between the partitions 22 and 24, the chamber 32 being defined between the partitions 24 and 26 and the chamber 34 being defined between the partition 26 and the end header 14. As shown in the drawing, the said transverse partitions are not equally spaced whereby the aforesaid chambers are of different lengths. The purpose of spacing the partitions to define chambers to different selected lengths will be explained hereinafter.

One of the chambers, preferably a chamber spaced from an end header, as for example the chamber 30, is an inlet chamber which receives the air stream from the blower or other source through an inlet fitting 36 which opens into the side of the shell 10. Preferably, the fitting 36 is welded to the shell and its connection is made more rigid and re-enforced by a plurality of gussets 38, 38. A plurality of side openings 40, 40 are defined in the conduit 18 within the chamber 30 to receive the air or gas stream therefrom.

It is an important feature of the present invention that the partition 22 between the chamber 28 and the inlet chamber 30 is provided with a plurality of circumaxially spaced apertures 42, 42 to effect acoustic communication and coupling between the said chambers whereby the chamber 28 adjacent the end header comprises a closed acoustic sidebranch communicating with the inlet chamber 30. It is a further acoustic feature of the present invention that a plurality of apertures 44, 44 are provided in the conduit 18 within the chamber 32 whereby to effect acoustic communication and coupling between the main gas and sound conducting channel and the chamber 32, and thus the chamber 32 comprises a closed acoustic sidebranch communicating with the said channel. Similarly, side openings 46, 46 are provided in the conduit 18 within the chamber 34 whereby that chamber also comprises a closed acoustic sidebranch communicating with the main sound conducting channel. The acoustic design and purpose of the closed sidebranches are well known in the art and need not be explained here. However, it should be noted that the inlet chamber 30 and the sidebranch chamber 28 cooperate to provide an attenuation surge chamber for incoming pulsations in the stream received from the inlet fitting 36. The sidebranch chamber 28 is preferably sized so as to be tuned to a high harmonic of the fundamental frequency of the pulsations anticipated whereby the sidebranch chamber 28 will carry less pulsating energy than would be the case if it were tuned to the fundamental frequency. The partition 22 also serves as a mechanical shield for the end header 12 whereby to avoid direct impingement on the said header of the high amplitude pulsations at fundamental frequency.

It is also preferred that the sidebranch chamber 32 be tuned to the fundamental frequency and the sidebranch chamber 34 be tuned to the second harmonic thereof, this in accord with practical acoustic design principle. In any event, the sidebranch chambers are large enough and are amply coupled to the main channel so that a continuous band of attenuation is attained, thereby making it unnecessary to design the sidebranch chambers with great precision as to size.

It has been found that the aforescribed silencer, in addition to providing the desired sound attenuation, has the mechanical strength necessary to withstand the pulsation energy. In the further interest of obtaining great mechanical strength, that portion of the shell 10 surrounding and defining the inlet chamber 30 and the sidebranch chamber 28 is preferably re-enforced with an outer jacket 48 whereby it can be said that the silencer shell 10 is of re-enforced laminated construction around the inlet chamber and the sidebranch chamber. The laminated construction has been found to reduce shell noise due to impingement of the pulsations in the gas stream and the laminated construction has been found to dampen or reduce low frequency vibration in the inlet chamber and the sidebranch chamber.

While the invention has been described with specific reference to a presently preferred embodiment, it will be understood that modifications can be effected within the scope of the invention as indicated by the claims which follow.

The invention claimed is:

1. A silencer comprising a generally cylindrical shell, a pair of headers closing the ends of the shell, at least one transverse partition disposed within said shell to define a plurality of chambers therein, one of the said chambers being an inlet chamber, means defining an inlet opening in the side of the shell and in communication with the inlet chamber and the said partition having at least one opening to effect acoustic coupling between the inlet chamber and an adjacent one of said chambers whereby the said adjacent chamber comprises a closed sidebranch acoustically coupled to the inlet chamber, and a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through said chambers and said partition with one end closed by and rigidly connected to one end header and with the other end rigidly connected to but opening through the other of said end headers, the said conduit being generally imperforate but having at least one side opening in said inlet chamber whereby to accommodate gas flow from said inlet chamber.

2. A silencer for gaseous streams comprising a generally cylindrical shell, a pair of headers closing the ends of the shell, a plurality of transverse partitions disposed within said shell to define at least three chambers therewithin, one of said chambers being an inlet chamber and one of the partitions defining said inlet chamber being provided with at least one opening to provide acoustic coupling between said inlet chamber and an adjacent one of said chambers whereby the said adjacent chamber comprises a closed sidebranch acoustically coupled to the inlet chamber, means defining an inlet opening in the side of the shell and in communication with the inlet chamber, and a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through all of the said chambers and the said partitions and having one end closed by and rigidly connected to one end header and its other end rigidly connected to but opening through the other end header, the said conduit being generally imperforate but having at least one side opening in said inlet chamber to accommodate gas flow therefrom and said conduit also being provided with at least one side opening in another of the said chambers other than the said acoustic sidebranch to provide acoustic coupling therewith whereby the said other chamber comprises a closed sidebranch acoustically coupled to the conduit.

3. A silencer for gaseous streams comprising a generally cylindrical shell, a pair of headers closing the ends of the shell, a plurality of transverse partitions disposed within said shell to define at least three chambers therewithin in cooperation with each other and with said end headers, one of the said chambers other than a chamber adjacent an end header comprising an inlet chamber, one of said partitions between said inlet chamber and

one of said chambers adjacent an end header being provided with at least one opening to effect acoustic coupling between said inlet chamber and the chamber adjacent said end header whereby said adjacent chamber comprises a closed sidebranch acoustically coupled to the inlet chamber, means defining an inlet opening in the side of the shell and in communication with the inlet chamber, and a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through said chambers and said partitions and having one end closed by and rigidly connected to one end header and its other end rigidly connected to but opening through the other end header, the said conduit being generally imperforate but having at least one side opening in the inlet chamber to accommodate gas flow therefrom and said conduit being provided with at least one side opening in another of said chambers other than the inlet chamber and its sidebranch to provide acoustic coupling between said other chamber and said conduit whereby said other chamber comprises a closed sidebranch acoustically coupled to the conduit.

4. A silencer for gaseous streams comprising a generally cylindrical shell, a pair of headers closing the ends of the shell, a plurality of transverse partitions disposed within the shell to define at least three chambers therewithin in cooperation with each other and with said end headers, two of said chambers being end chambers and another of said chambers being an intermediate chamber, the two end chambers comprising acoustic sidebranches and said intermediate chamber comprising an inlet chamber, the partition separating one end chamber and the inlet chamber being provided with at least one opening for acoustic coupling between the said one end chamber and the inlet chamber, means defining an inlet opening in said shell in communication with the inlet chamber, and a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through said chambers and being rigidly connected to said partitions with one end closed by and rigidly connected to the one end header in said one end chamber and with its other end rigidly connected to but opening through the other end header in the other end chamber, the said conduit being generally imperforate but having at least one side opening in the inlet chamber to accommodate gas flow therefrom and also being provided with at least one side opening in said other end chamber to effect acoustic coupling therewith.

5. A silencer for gaseous streams comprising a generally cylindrical shell, a pair of headers closing the ends of the shell, three longitudinally spaced transverse partitions disposed within the shell to define four chambers therewithin, the said chambers comprising from one end to the other end of the shell a sidebranch chamber, an inlet chamber, and two additional sidebranch chambers, the partition separating the first mentioned sidebranch chamber and the inlet chamber being provided with at least one opening for acoustic coupling therebetween, means defining an inlet opening in said shell in communication with the inlet chamber, and a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through all of said chambers and being rigidly connected to said partitions with one end closed by and rigidly connected to the one end header in said first mentioned sidebranch chamber and with its other end rigidly connected to but opening through the other end header, the said conduit being generally imperforate but having at least one side opening in the inlet chamber to accommodate gas flow therefrom and also being provided with at least one side opening in each of the said two additional sidebranch chambers to provide acoustic coupling therewith.

6. A silencer for gaseous streams comprising a generally cylindrical shell, a pair of headers closing the

5

ends of the shell, a plurality of transverse partitions disposed within the shell to define at least three chambers therewithin in cooperation with each other and with said end headers, two of said chambers being end chambers and another of said chambers being an intermediate chamber, the two end chambers comprising acoustic sidebranches and said intermediate chamber comprising an inlet chamber, the partition separating one end chamber and the inlet chamber being provided with at least one opening for acoustic coupling 10 between the said one end chamber and the inlet chamber, means defining an inlet opening in said shell in communication with the inlet chamber, a main gas and sound conducting conduit located centrally of the shell and extending longitudinally therein through said chambers 15 and being rigidly connected to said partitions with one end closed by and rigidly connected to the one end header in said one end chamber and with its other end rigidly connected to but opening through the other end header in the other end chamber, the said conduit being 20 generally imperforate but having at least one side opening in the inlet chamber to accommodate gas flow therefrom and also being provided with at least one side opening in said other end chamber to effect acoustic coupling therewith, and a generally cylindrical open end jacket surrounding and secured to that portion of the shell wherein the said one end chamber and the inlet chamber are defined.

6

ing in the inlet chamber to accommodate gas flow therefrom and also being provided with at least one side opening in said other end chamber to effect acoustic coupling therewith, and a generally cylindrical open end jacket surrounding and secured to that portion of the shell wherein the said one end chamber and the inlet chamber are defined.

## References Cited in the file of this patent

## UNITED STATES PATENTS

|           |              |               |
|-----------|--------------|---------------|
| 2,138,477 | Ludlow ----- | Nov. 29, 1938 |
| 2,274,459 | Rauen -----  | Feb. 24, 1942 |
| 2,277,132 | Moss -----   | Mar. 24, 1942 |
| 2,339,834 | Bourne ----- | Jan. 25, 1944 |
| 2,520,756 | Bryant ----- | Aug. 29, 1950 |

## FOREIGN PATENTS

|         |                     |              |
|---------|---------------------|--------------|
| 265     | Great Britain ----- | Jan. 5, 1914 |
| (1913)  |                     |              |
| 471,143 | France -----        | July 2, 1914 |