Sept. 22, 1953 G. M. WALTON ET AL 2,652,899

SILENCER WITH A RESONANCE CHAMBER

Filed Feb. 13, 1948

3 Sheets-Sheet 1

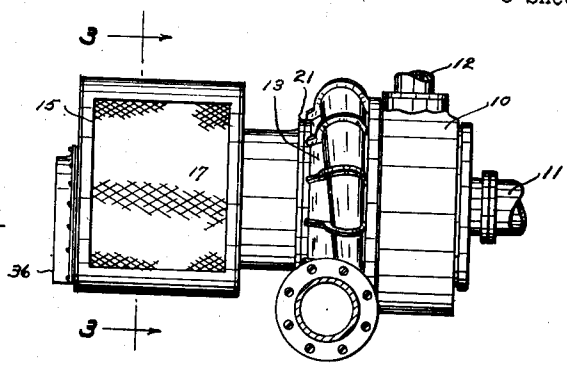


Fig. 1

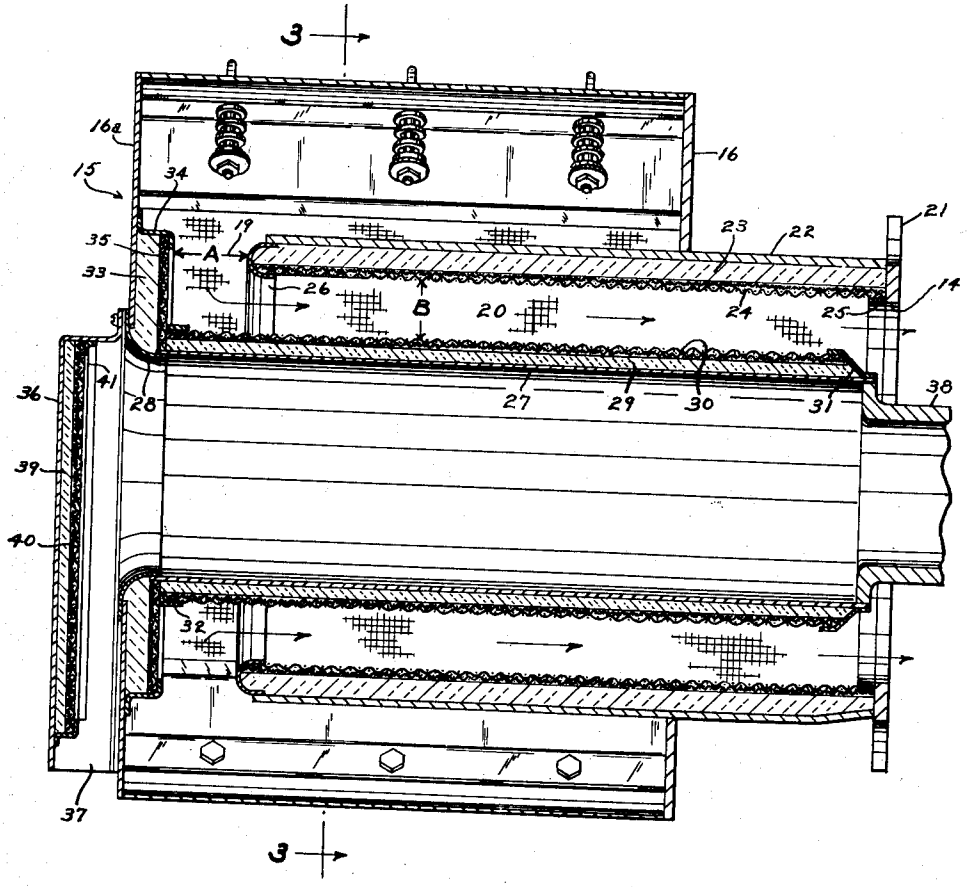


Fig. 2

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3 Sheets-Sheet 2

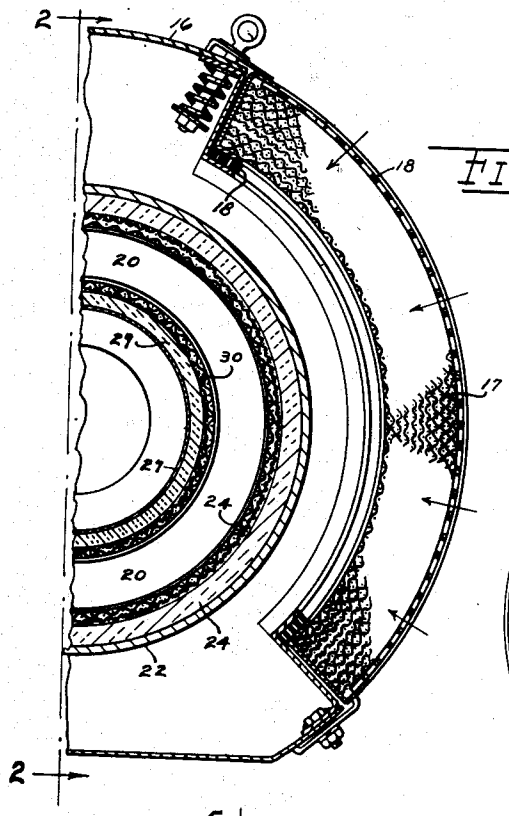


FIG. 3

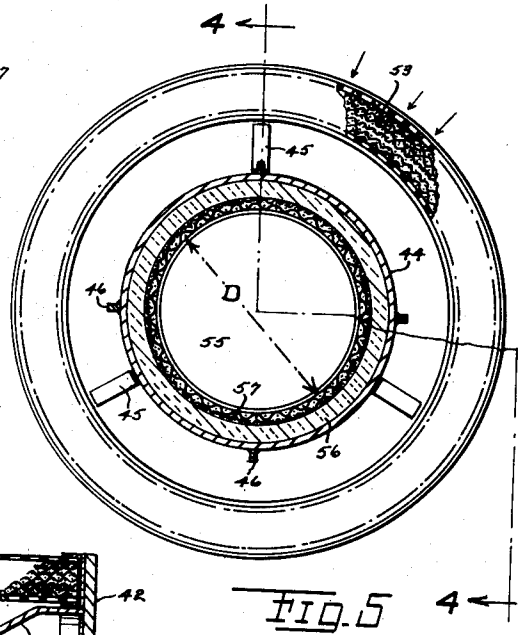


FIG. 5

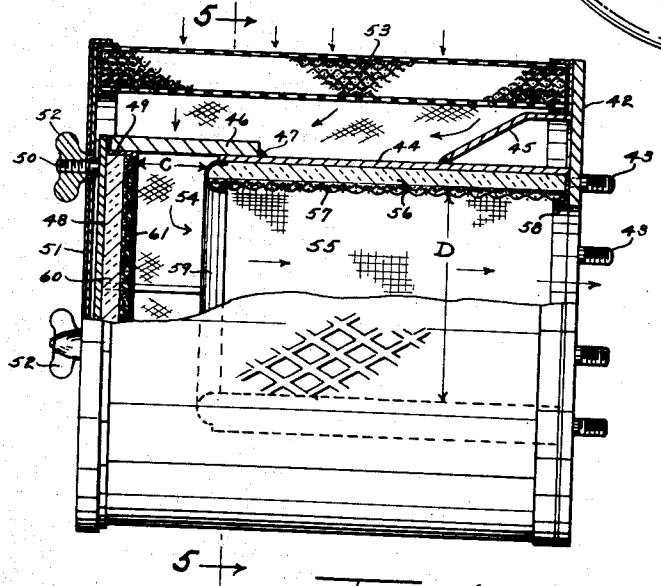


FIG. 4

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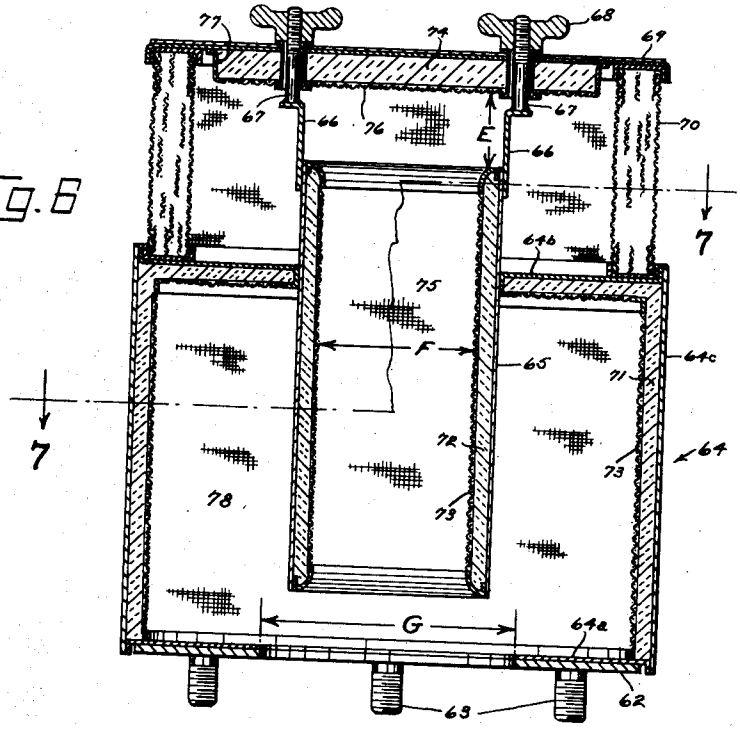
Sept. 22, 1953 G. M. WALTON ET AL 2,652,899

SILENCER WITH A RESONANCE CHAMBER

Filed Feb. 13, 1948

3 Sheets-Sheet 3

Fig. 6



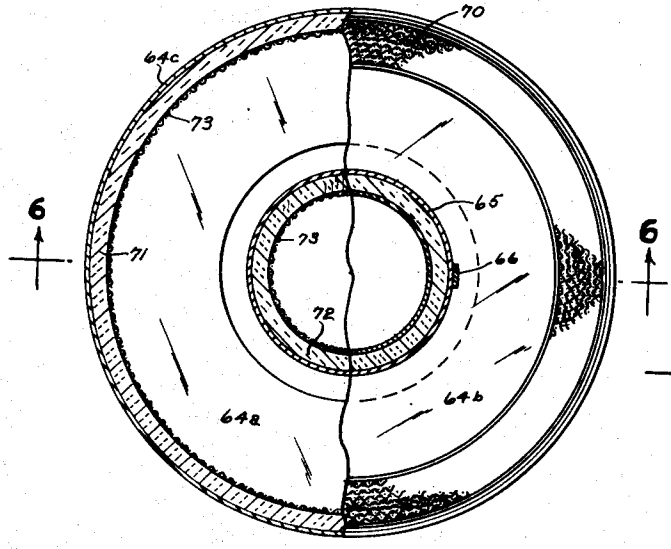


Fig. 7

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SILENCER WITH A RESONANCE CHAMBER

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Application February 13, 1948, Serial No. 8,088

4 Claims. (Cl. 181—42)

1

This invention relates to improvements in a silencer for use with a stream of air or other gas flowing to a fan, blower, or supercharger or the like.

One of the objects of the present invention is to provide a silencing device adapted to silence sound waves of the order of two thousand cycles per second and higher.

Another object of the present invention is to provide a novel device for silencing sound waves of the order of eight hundred to two thousand cycles per second.

Still another object of the invention is to provide a novel silencer for a turbocharger wherein the arrangement for silencing is combined in a novel manner with means for providing lubricant to the apparatus producing the sound.

Other objects and advantages of the present invention will be apparent from the accompanying drawings and description and the essential features will be set forth in the appended claims.

In the drawings,

Fig. 1 is a side elevational view of a turbine driven supercharger equipped with our invention;

Fig. 2 is an enlarged sectional view of the same taken along the line 2—2 of Fig. 3;

Fig. 3 is an enlarged sectional view taken along the line 3—3 of Fig. 1 or a transverse sectional view taken along the line 3—3 of Fig. 2;

Fig. 4 is a view of a modification showing in part a side elevational view and in part a central sectional view taken along the line 4—4 of Fig. 5;

Fig. 5 is a sectional view taken along the line 5—5 of Fig. 4;

Fig. 6 is a sectional view taken along the line 6—6 of Fig. 7 and showing another modification, while

Fig. 7 is a transverse sectional view taken along the line 7—7 of Fig. 6.

The device shown in Fig. 1 comprises a gas turbine 10 having an inlet at 11 and an outlet at 12 for exhaust gases from a diesel engine or the like. This turbine drives an air supercharger indicated at 13 and having an air inlet at 14 (Fig. 2) for air admitted through the combination filter and silencer indicated at 15. As shown in Figs. 1, 2, and 3, an outer casing 16 supports two arcuate filter elements 17, each of which is preferably confined between expanded metal plates 18. Air entering in the direction of the arrows of Figs. 2 and 3, after passing through the filter elements, enters an annular throat 19 moving in a radial direction as clearly shown in Fig. 2. The air stream then turns and moves in an

2

axial direction through an annular passageway 20 which communicates with the opening 14 leading to the supercharger 13.

The construction of the silencing portions of the member 15 may be clearly understood from Figs. 2 and 3. A base plate 21 is secured by suitable means not shown to the supercharger 13. Rigid with this base plate is a cylinder 22 which supports the housing 16 already mentioned. The interior wall of the cylindrical plate 22 is covered by soundproofing material 23 which may be of felt, cotton, or other similar material held in place by a cylindrical layer 24 of woven wire screen, hardware cloth, or the like, which in turn is held in position at one end by the ring 25 and at the other end by the binding ring 26. The other wall of the annular passageway 20 is formed by means of a cylindrical plate 27 which is rigidly secured at its outer end to a flared ring 28 which in turn is rigidly mounted on the housing 16. The outer face of the wall 27 is provided with a layer of soundproof material 29 which is similar to the soundproofing material 23. This layer is held in place by a cylindrical layer 30 of woven wire screen, hardware cloth, or the like, which is held at one end by means of a frustro conical ring 31 rigidly secured to the plate 27. At its other end a binding ring 32 holds the soundproofing material in place. The end plate 16a of the housing 16 is soundproofed opposite the chamber 20. This is accomplished by fixing an annular ring 33 of soundproofing material to the plate 16a by means of a binding ring 34 and a layer 35 of woven wire screen, hardware cloth, or the like.

The space located centrally of the cylindrical wall 27 is utilized for the introduction of lubricating apparatus necessary for the lubrication of the rotating parts of the turbine 10 and the supercharger 13. A skirt 36 is secured to the end wall 16a spaced from the end of the opening of the cylinder 27. This skirt 36 is closed on all sides except the bottom where lubricant pipes are adapted to enter. Practically no air will be drawn through the opening 37 at the bottom of the skirt 36 because of a sleeve 38 secured to the inner end of the wall 27 and extending through the center of the rotating parts so as to supply oil thereto. To prevent noise being transmitted through the skirt 36 the inner face thereof is lined with a sound deadening layer 39 held in position by means of a layer 40 of woven mesh screen or the like which in turn is held in place by a U-shaped ring 41 secured to the skirt 36.

In apparatus of the type described very high

pitched sounds are transmitted back along the air stream through the chamber 20 and the annular throat opening 19. These sounds are of the order of two thousand cycles per second and higher. We find that such sounds are reduced to an acceptable audible level if the annular area across the dimension A of Fig. 2 is approximately between one hundred and one hundred and fifty per cent of the annular area indicated at B in Fig. 2. If the area at A is perceptibly above one hundred and fifty per cent of the area at B, there is a great loss in the efficiency of the silencing. Obviously the sound waves impinge freely upon the insulating material 29, 23, and 33 through the screen layers 30, 24, and 35 respectively.

The modification of Figs. 4 and 5 is used for the silencing of sounds of the order of two thousand cycles per second and higher, in such cases as do not require the central opening for the introduction of lubricating pipes as shown in our first described form. Here the base plate 42 is provided with studs 43 for attachment to the supercharger fan or blower. A cylindrical wall 44 is rigidly secured to the base plate 42 and is stiffened by means of the braces 45 if necessary. Spacer members 46 are rigidly secured to the outer end of the cylinder 44, for instance, by means of the welding shown at 47. At the outer ends of these spacer members I secure a plate 48 rigidly attached to the spacer members as by welding through the insulation retainer ring 49. Studs 50 are rigidly secured to the plate 48. A top cover plate 51 is held in position by thumb nuts 52 secured to the studs 50. Held between the plate 51 and the base plate 42 is an annular filter element 53. Air entering through this filter element passes in the direction of the arrows of Fig. 4 first through the annular throat 54 and then through the central opening 55 to the supercharger or the like. The inner face of wall 44 is lined with soundproofing material 56 of felt, cotton, or the like, held in position by a layer 57 of woven wire screen, hardware cloth, or the like. At its inner end a ring 58 holds the soundproofing material in position and at its outer end a binding ring 59 also holds the soundproof layer to the wall 44. Axially opposite the chamber 55, the plate 48 is provided with a lining of soundproofing material 60 which is held in position by a layer 61 of woven wire screen or hardware cloth which in turn is held by the ring 49 previously mentioned.

As in the first described form, we prefer to make the annular area indicated at C in Fig. 4 between one hundred and one hundred and fifty per cent of the area indicated at D across the chamber 55. If C is substantially greater than one hundred and fifty per cent of D then there is a loss in silencing efficiency. Obviously any sound waves travelling outwardly along the air stream will impinge upon the sound deadening layers 56 or 60 before they can be transmitted into the room.

In the modification of Figs. 6 and 7, we show a device which is useful for sound waves which may include frequencies as low as approximately eight hundred cycles per second or as high as two thousand cycles per second. In this form of our device a base plate 62 is provided with studs 63 for securing the silencer device to the noise producing apparatus. Rigidly secured to the plate 62 is a container 64 comprising end plates 64*a* and 64*b* joined together by a cylindrical side wall 64*c*. The end plate 64*b* rigidly supports a cylindrical wall 65 which is concentric with the wall 64*c*. The wall 65 has secured at its outer end a plurality of spacers 66 which in turn rigidly support studs 67. Wing nuts 68 secured to the studs hold the end plate 69 in a manner to clamp an annular filter element 70 against the plate 64*b*. The walls 64*b*, 64*c*, and 65 are lined with sound deadening material as indicated at 71 and 72. Foraminous layers 73 hold the sound deadening material in position as shown. A layer of sound deadening material 74 is positioned axially opposite the chamber 75 in the center of the wall 65. This sound deadening material 74 is held in position by a foraminous layer 76 which in turn is held by a ring 77 secured to plate 69.

In this form of our device the annular opening indicated at E in Fig. 6 is approximately in the range from one hundred to one hundred and fifty per cent of the area indicated at F centrally of the chamber 75. The area at F is also made approximately seventy per cent of the area indicated at G where the air stream passes to the air moving device.

In the use of the device shown in Figs. 6 and 7, the sound waves of the lower frequencies are silenced by means of the resonance chamber 78 coupled with the restriction through the chamber 75. The higher frequencies are silenced as in the previously described forms because of the relationship between the areas E and F.

What we claim is:

1. In a silencer, the combination of a wall surrounding an orifice, a cylindrical tube having one end spaced from said wall and concentric with said orifice, a second wall spaced from the other end of said tube and opposite said other end and providing an anunlar throat there, a resonance chamber communicating with said one end of said tube and including said first named wall, and the area of said annular throat being of the order of one hundred to one hundred and fifty percent of the flow area of said tube.

2. In a silencer, the combination of a wall surrounding an orifice, a cylindrical tube having one end spaced from said wall and concentric with said orifice, a second wall spaced from the other end of said tube and opposite said other end and providing an annular throat there, a resonance chamber communicating with said one end of said tube and including said first named wall, the area of said annular throat being of the order of one hundred to one hundred and fifty per cent of the flow area of said tube, and the flow area of said tube being of the order of seventy percent of the area of said orifice.

3. In a silencer, the combination of a wall surrounding an orifice, a cylindrical tube having one end spaced from said wall and concentric with said orifice, a second wall spaced from the other end of said tube and providing an annular throat there, a resonance chamber communicating with said one end of said tube and including said first named wall, the inside of said tube and said second wall opposite said tube being lined with sound proofing material, and the area of said annular throat being of the order of one hundred to one hundred and fifty percent of the cross-sectional area of said tube.

4. In a silencer, the combination of a wall surrounding an orifice, a cylindrical tube having one end spaced from said wall and concentric with said orifice, a second wall spaced from the other end of said tube and opposite said other end and providing an annular throat there, a resonance

chamber communicating with said one end of said tube and including said first named wall, the inside of said tube being lined with sound proofing material, and the area of said annular throat being of the order of one hundred to one hundred and fifty percent of the cross-sectional area of said tube.

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