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ACOUSTIC METHOD AND SYSTEM

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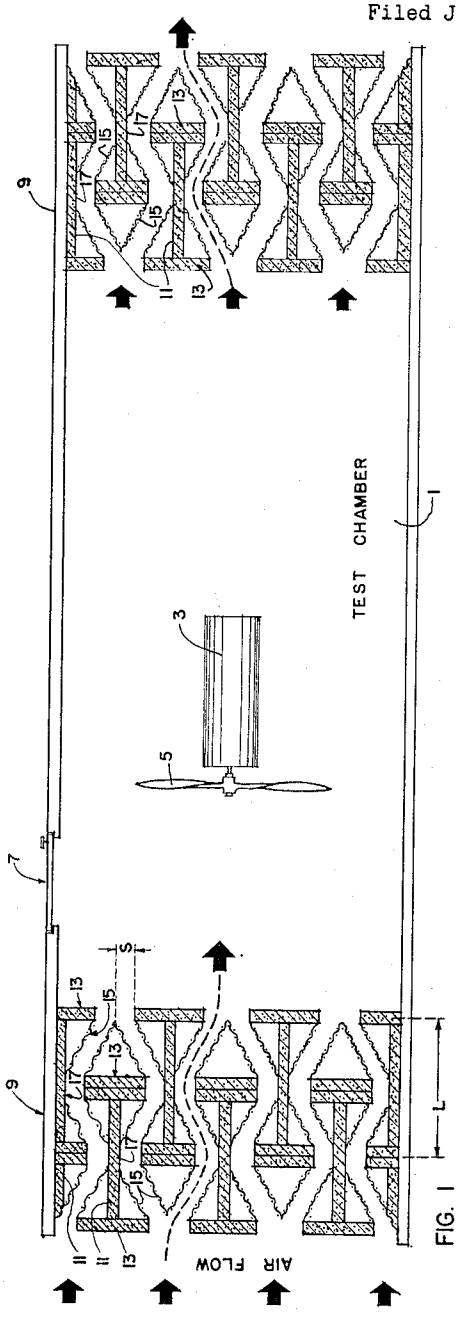


FIG. 1

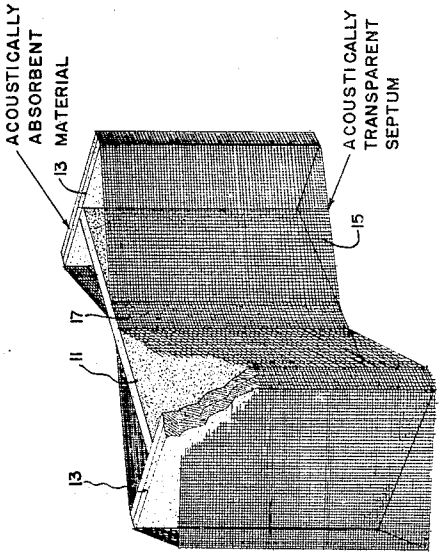


FIG. 3

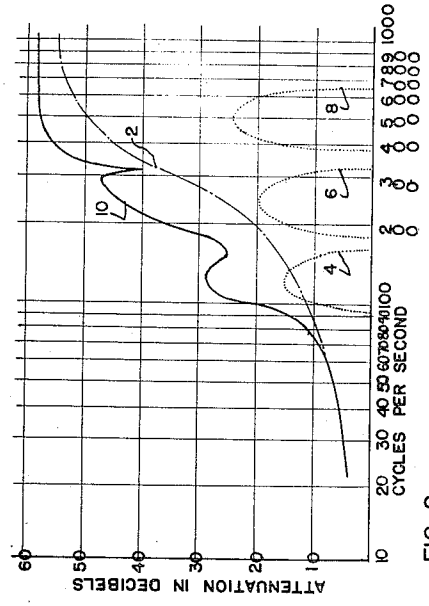


FIG. 2

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ACOUSTIC METHOD AND SYSTEM

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The present invention relates to acoustic methods and systems, and, more particularly, to methods of and systems for reducing the intensity of sound energy accompanying the flow of a fluid medium within a confined space.

It is frequently desired to eliminate or markedly reduce the intensity of sound energy accompanying the flow of a fluid medium, such as air, through a confined space. In test chambers, for example, for testing the performance of aircraft engines and propellers, air passing through the chambers carries with it audible noise sounds produced by the operation of the engine and propeller of sufficient intensity to bring discomfort to the human ear. Several devices have been proposed for reducing the level of intensity of these disturbing audio-frequency components of the sound energy emitted from test chambers, but these are all attendant with serious disadvantages.

Among these devices has been a terminal portion for the test chamber divided into a plurality of ducts lined with sound-absorbing material and resonant at certain disturbing audio sound-frequencies in order to attenuate the said frequencies passing from the test chamber through terminal-portion ducts. Such ducts are usually employed for attenuating the very low frequency audible sounds. In order to attenuate the somewhat higher audio frequencies, the test chamber is provided with further portions containing baffles. For use with the above-mentioned aircraft engine and propeller test chambers, however, the duct and baffle portions must have a very considerable overall length, of from about thirty to seventy feet, in order to effect the desired result. This technique, in addition, does not lend itself to the scaling or proportioning of the dimensions of the sound-absorbing system for different frequencies, as for the purpose of attenuating somewhat different frequency bands. Such a structure, furthermore, is subject to high aerodynamic losses because of the twisting action upon the air flowing through the ducts and then through the baffles. It is quite difficult, moreover, to install such a system, and the masonry and steel-supporting structure necessary to effect the same is quite extensive.

Another technique proposed for solving this problem has been to utilize a labyrinth in which wall sections project from opposite sides of the terminal portions of the test chamber in order to provide a crooked path for the travel of both air and sound. These wall sections are provided with sound-absorptive layers in order to attenuate the higher audio frequency components of the sound energy which tend to travel in straight lines. Again, however, considerable expense and size is required to enclose a labyrinth at the ends of a standard test cell. The aerodynamic losses attendant upon the forcing of the air through this crooked course, moreover, are high, and the turbulence introduced by the air passing through the labyrinth very often imposes severe mechanical strains upon the propeller or other device being tested in the test chamber.

An object of the present invention is to provide a new and improved method of and system for reducing the intensity of sound energy of a band of frequencies accompanying the flow of a fluid medium through a confined space that shall not be subject to the above-described disadvantages.

A further object of the invention is to provide an attenuator for the said band of frequencies which may occupy a relatively small space and necessitate a minimum of installation work and expense in adapting the same to standard test chambers.

Still another object of the present invention is to provide stream-lining for the flow of the air or other fluid medium while effecting the above-described attenuation.

Other and further objects will be described hereinafter and will be more particularly pointed out in the appended claims.

In summary, the invention relates to a method of and system for causing a fluid medium containing sound energy of a band of frequencies to travel along a zig-zag path, absorbing the high sound frequencies of the said band of frequencies as the medium travels along the said zig-zag path, and fixing the crests of the zig-zag path substantially in accordance with the half wave-length of the intermediate sound frequencies of the said band of frequencies in order to resonate the said intermediate frequencies, thereby to attenuate the same. Preferred constructional details are treated hereinafter.

The invention will now be described in connection with the accompanying drawing,

Fig. 1 of which is a plan view of a test chamber embodying the present invention in preferred form, the roof of the test chamber being removed,

Fig. 2 is a graph illustrating experimentally obtained characteristics of the chamber of Fig. 1, and

Fig. 3 is a perspective view, partly broken away in order to show details, of a section of the preferred sound-absorbing device utilized in the system of Fig. 1.

Referring to Fig. 1, a test chamber **1** is shown centrally provided with an engine **3** for driving a propeller **5**, for test purposes, mounted upon the floor of the chamber in the customary manner. A door **7** in a side wall of the test chamber **1** may be provided to permit access to the test chamber. At each end of the test chamber is disposed a terminal section **9** provided with a plurality of longitudinally extending planar sound-absorbing devices **11**. These sound-absorbing devices may be formed of fibre glass, rock wool, packed felt, or any other desired sound-absorbing material that can be fabricated in sturdy sections. The devices **11** extend from the floor of the test chamber to the roof. At periodically spaced intervals, the otherwise uniform planar devices **11** are provided with baffles **13** of the same acoustically absorbent material. The baffles **13** thus form the largest transverse dimension of the sound-absorbing devices, and they are positioned so that the baffles **13** of successive sound-absorbing devices are staggered across the test chamber. Thus, for example, the baffles **13** of the second sound-absorbing device **11** in from either wall, as shown in Fig. 1, are disposed between the baffles **13** of the first and third sound-absorbing devices **11**. While, in Fig. 1, each sound-absorbing device **11** is shown provided with but two baffles **13**, this is merely for purposes of illustration, it being understood that, in actual practice, two or more such baffles may be employed depending upon the degree of attenuation and other characteristics desired. Air passing from the left of Fig. 1, through the left-hand terminal section **9**, the central portion of the test chamber **1** and the right-hand terminal section **9**, in the direction of the arrows, is thus forced,

as a result of this construction, to travel in zig-zag paths between the adjacent sound-absorbing devices 11—13.

Since the higher audio sounds generated by the engine 3 and/or propeller 5 tend to travel in straight lines, they become absorbed as the air carrying the sound is forced to travel the said zig-zag paths between adjacent sound-absorbing devices 11—13. In Fig. 2, the dash-dot curve 2 represents the variation of attenuation, produced by the effect of these zig-zag paths, with frequency of the sound energy accompanying the flow of air, attenuation being plotted as the ordinate in units of decibels, and the frequency, as the abscissa, in units of cycles per second. While this zig-zag path satisfactorily attenuates the higher audio-frequency components, say in the neighborhood of 600 to 1000 cycles per second, the attenuation in the intermediate-frequency region of, for example, 100 to 500 cycles per second, is not satisfactory to produce the desired degree of elimination of sound in this frequency range. At 100 cycles, for example, only about 11 decibels of attenuation are provided; at 200 cycles, about 20 decibels; while at 500 cycles, about 50 decibels of attenuation are produced. In accordance with the present invention, the intermediate sound frequencies of from about 100 to about 500 cycles, are further attenuated by proper spacing of the longitudinal separation L of the baffles 13 of each device 11—13. By spacing the successive crests, namely the successive direction-changing points, of the big-zag paths, to correspond substantially to the half wave-length of these intermediate sound frequencies, such further attenuation is achieved. In actual practice, an average or mean wavelength of the band of intermediate frequencies may be employed. The use of such periodic or tuned half-wavelength spacing of the sound-absorbent baffles 13 of adjacent sound-absorbing devices 11 of itself produces the plurality of peaked attenuation characteristics shown in the three dotted curves 4, 6 and 8 of Fig. 2. This periodic structure, in effect, causes resonance, actually multiple resonances 4, 6 and 8, of the intermediate sound frequencies in the space between successive baffles, thereby effecting further attenuation by the acoustically absorbent material of the devices 11—13. The operation of the system may be more easily understood by considering that the transversely extending baffles 13 provide constrictions to the sound energy traveling between the longitudinally extending members 11 since the transverse separation between adjacent devices 11 becomes reduced at the baffles 13. Such constrictions present an increase in impedance to the flow of the sound energy. When such impedance increases are made to occur periodically at successive intervals corresponding substantially to the half-wavelength of particular-frequencied sound energy, or multiples thereof, there is produced at such successive intervals a very high overall impedance to the flow of that sound energy, thus appreciably further attenuating such sound energy, as illustrated at 4, 6 and 8. In the tests plotted in Fig. 2, these multiple resonance characteristics are produced by this structure in the neighborhood of about 130 cycles, about 250 cycles, and about 500 cycles.

The resultant effect of the before-mentioned zigzag-path attenuation 2, and the periodic spacing attenuation 4, 6, 8, is plotted as the solid-line curve 10 of Fig. 2. It will be observed that the intermediate frequencies from about 100 cycles up to about 500 cycles are appreciably attenuated with from about 28 to about 58 decibels of attenuation, and that the high frequencies of the band above about 600 cycles are attenuated with about 58 decibels of attenuation. High attenuation is not so imperative for the very low frequencies, below about 100 cycles, inasmuch as they are not so disturbing to the human ear.

Though the before-described resultant attenuation characteristic 10 is satisfactory insofar as the acoustic results are concerned, the baffles 13 present an obstruction to the flow of air. As a result of the structure of

the apparatus employed in accordance with the present invention, however, this obstruction is easily overcome by securing an acoustically transparent septum 15 between the baffles 13 and, for example, the mid-regions 17 of the sound-absorbing devices 11 disposed between adjacent baffles 13. This acoustically transparent septum may, as an illustration, assume the form of wire screening. A streamlined zig-zag path, preferably of substantially uniform width S, is thus provided permitting air flow without obstruction, but allowing the sound to pass through the septum 15 to the absorbing material of the devices 11—13 in order to produce the before-described resultant attenuation effect 10, Fig. 2.

As an illustration of a typical installation in a standard aircraft engine test chamber for producing results similar to those shown in Fig. 2, the transverse spacing S defining the width of the zig-zag paths between the longitudinally extending sound-absorbing devices 11—13 may have a value of from about 2 to about 6 feet, and the longitudinal separation L of the successive baffles 13 of each device 11—13 may have a value from about 4 to about 12 feet.

In accordance with a further feature of the present-invention, if it is desired to shift the resultant attenuation curve 10 to the left or to the right in order to cover lower or higher frequency bands for any particular application, it is merely necessary correspondingly to scale or proportionately reduce or increase the before-mentioned dimensions, thereby automatically to produce the desired attenuation characteristic 10 over the desired frequency band. This is extremely convenient inasmuch as a single design of an installation, such as that illustrated in Fig. 1, will permit the adaptation of the design to other frequency bands by this simple proportionate scaling process alone.

While the invention has been described in connection with a test chamber for aircraft engines and propellers, it is to be understood that these techniques are equally applicable to other systems in which a fluid medium containing undesired sound energy is passed through a confined space, such as, for example, in air-conditioning plants or in muffler systems, and the like. It is also to be understood that it is not essential that the devices 11—13 have the strictly planar or strictly rectangular configuration illustrated in the drawing, but that other shapes may similarly be employed to provide the desired zig-zag paths and the desired periodic resonant spacing of the successively disposed baffles.

Other and further modifications will occur to those skilled in the art and all such are considered to fall within the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices spaced transversely within the confined space and shaped to provide for the sound energy a zig-zag path or paths there-between of varying transverse dimensions, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the medium along the zig-zag path or paths, successive crests of the zig-zag path or paths being spaced longitudinally a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

2. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices each of periodically varying trans-

verse dimension spaced transversely within the confined space with the largest transverse dimension of each device disposed substantially opposite to the smallest dimension of the device or devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the medium along the resulting zig-zag path or paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

3. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices each of varying transverse dimension spaced transversely within the confined space with the largest transverse dimension of each device longitudinally displaced from the largest transverse dimension of the device or devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the medium along the resulting zig-zag path or paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

4. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices each of varying transverse dimension spaced transversely within the confined space with the largest transverse dimension of each device longitudinally displaced from the largest transverse dimension of the device or devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the medium along the resulting zig-zag path or paths, and a smooth lining extending from the largest to the smallest transverse dimensions of each device to stream-line the flow of the medium along the said zig-zag path or paths.

5. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices each of varying transverse dimension spaced transversely within the confined space with the largest transverse dimension of each device longitudinally displaced from the largest transverse dimension of the device or device disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the medium along the resulting zig-zag path or paths, and a smooth lining disposed between the largest and smallest transverse dimensions of each device to stream-line the flow of the medium along the said zig-zag path or paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

6. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of periodically varying transverse dimension substantially equally spaced transversely within the confined space with the largest transverse dimension of each

device disposed substantially opposite to the smallest dimension of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

7. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of periodically varying transverse dimension substantially equally spaced transversely within the confined space with the largest transverse dimension of each device disposed substantially opposite to the smallest dimension of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and a smooth lining disposed between the largest and smallest transverse dimensions of each device to stream-line the flow of the air along the said zig-zag paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

8. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of periodically varying transverse dimension substantially equally spaced transversely within the confined space with the largest transverse dimension of each device disposed substantially opposite to the smallest dimension of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and a smooth acoustically transparent lining disposed between the largest and smallest transverse dimensions of each device to stream-line the flow of the air along the said zig-zag paths, the largest transverse dimensions of each device being separated from one another a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

9. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of substantially uniform transverse dimension and provided with a plurality of separated sound-absorbing baffles of greater transverse dimension, the devices being substantially equally spaced transversely within the confined space with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, the separation of the baffles of each device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

10. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of substantially uniform transverse dimension

and provided with a plurality of separated sound-absorbing baffles of greater transverse dimension, the devices being substantially equally spaced transversely within the confined space with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and an acoustically transparent lining disposed between the baffles of each device along the said zig-zag paths to stream-line the flow of air therealong, the separation of the baffles of each device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

11. In an aerodynamic test chamber in which air is adapted to flow longitudinally through the chamber in response to the rotation of a propeller and the like within the chamber, means disposed at each end of the test chamber for reducing the intensity of sound energy of a band of frequencies generated by the rotation of the propeller and the like and accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of periodically varying transverse dimension spaced transversely within the ends of the test chamber with the largest transverse dimension of each device disposed substantially opposite to the smallest dimension of the device or devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and a smooth lining disposed between the largest and smallest transverse dimensions of each device to stream-line the flow of the air along the said zig-zag path or paths, the largest transverse dimensions of each device being separated from one another distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

12. In an aerodynamic test chamber in which air is adapted to flow longitudinally through the chamber in response to the rotation of a propeller and the like within the chamber, means disposed at each end of the test chamber for reducing the intensity of sound energy of a band of frequencies generated by the rotation of the propeller and the like and accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each of substantially uniform transverse dimension and provided with a plurality of separated sound-absorbing baffles of greater transverse dimension, the devices being substantially equally spaced transversely within the ends of the test chamber with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and an acoustically transparent lining disposed between the baffles of each device along the said zig-zag paths to stream-line the flow of air therealong, the separation of the baffles of each device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

13. An apparatus as claimed in claim 12 and in which the transverse spacing between the said longitudinally extending sound-absorbing devices is from about 2 to about 6 feet, and the separation of the baffles of each device from one another is from about 4 to 12 feet.

14. A method of the character described that comprises causing sound energy of a band of frequencies to travel in a fluid medium along a zig-zag path of varying transverse dimensions, absorbing the high sound frequencies of the said band of frequencies as the sound energy travels along the said zig-zag path, and fixing the successive crests of the path substantially in accordance with the half-wavelength of the intermediate sound frequencies of the said band of frequencies in order to resonate the said intermediate frequencies, thereby to attenuate the said intermediate frequencies.

15. A method of the character described that comprises causing sound energy of a band of frequencies to travel in air along a zig-zag path of varying transverse dimensions, absorbing the high sound frequencies of the said band of frequencies as the sound energy travels along the said zig-zag path, and fixing the successive crests of the zig-zag path substantially in accordance with the half-wavelength of the intermediate sound frequencies of the said band of frequencies in order to resonate the said intermediate frequencies, thereby to attenuate the said intermediate frequencies.

16. A method of the character described that comprises causing sound energy of a band of frequencies to travel in air along a zig-zag path of varying transverse dimension, stream-lining the air flow along the zig-zag path, absorbing the high sound frequencies of the said band of frequencies as the sound energy travels along the said zig-zag path, and fixing the successive crests of the zig-zag path substantially in accordance with the half-wavelength of the intermediate sound frequencies of the said band of frequencies in order to resonate the said intermediate frequencies, thereby to attenuate the said intermediate frequencies.

17. A method of the character described that comprises causing sound energy of a band of frequencies to travel in air along a plurality of successively converging and diverging zig-zag paths of varying transverse dimensions, absorbing the high sound frequencies of the said band of frequencies as the sound energy travels along the said zig-zag paths, and fixing the successive crests of each zig-zag path substantially in accordance with the half-wavelength of the intermediate sound frequencies of the said band of frequencies in order to resonate the said intermediate frequencies, thereby to attenuate the said intermediate frequencies.

18. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices of varying transverse dimensions spaced transversely within the confined space to provide a path or paths of successively increasing and decreasing transverse dimensions through which high sound frequencies of the said band of frequencies are forced to travel in zig-zag fashion, whereby the high sound frequencies of the said band of frequencies become attenuated during such travel, successive regions of decreased transverse dimensions of each path or paths being separated from one another by a spacing resonant to the intermediate sound frequencies of the said band of frequencies in order attenuate the said intermediate frequencies.

19. In an acoustic system in which a fluid medium is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices spaced transversely within the confined space and shaped to force the high sound frequencies of the said band of frequencies to travel in a zig-zag path or paths therebetween, whereby the high sound frequencies of the said band of frequencies become attenuated during such travel, and means for providing a high impedance to the flow of the sound energy along the zig-zag path or paths at intervals spaced longitudinally therealong a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

20. In an acoustic system in which a fluid medium is

adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the medium comprising a plurality of longitudinally extending sound-absorbing devices spaced transversely within the confined space and of periodically varying transverse-dimensional shape to force the high sound frequencies of the said band of frequencies to travel in a zig-zag path or paths therebetween, whereby the high sound frequencies of the said band of frequencies become attenuated during such travel, the successive direction-changing points of the zig-zag path or paths being spaced longitudinally a distance corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to provide a high impedance to the flow of the sound energy at intervals spaced longitudinally a distance corresponding to the said half-wavelength, thereby to attenuate the said intermediate frequencies.

21. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each provided with a plurality of separated sound-absorbing baffles of greater transverse dimension than other portions of the devices, the devices being substantially equally spaced transversely within the confined space with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, the separation of the baffles of each device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

22. In an acoustic system in which air is adapted to flow longitudinally through a confined space, means for reducing the intensity of sound energy of a band of frequencies accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each provided with a plurality of separated sound-absorbing baffles of greater transverse dimension than other portions of the devices, the devices being substantially equally spaced transversely within the confined space with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and an acoustically transparent lining disposed between the baffles of each device along the said zig-zag paths to stream-line the flow of air therealong, the separation of the baffles of each

device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order ot attenuate the said intermediate frequencies.

23. In an aerodynamic test chamber in which air is adapted to flow longitudinally through the chamber in response to the rotation of a propeller and the like within the chamber, means disposed at each end of the test chamber for reducing the intensity of sound energy of a band of frequencies generated by the rotation of the propeller and the like and accompanying the flow of the air comprising a plurality of longitudinally extending sound-absorbing devices each provided with a plurality of separated sound-absorbing baffles of greater transverse dimension than other portions of the devices, the devices being substantially equally spaced transversely within the ends of the test chamber with the baffles of each device disposed between the baffles of the devices disposed adjacent thereto, whereby the high sound frequencies of the said band of frequencies become attenuated during the travel of the air along the resulting zig-zag paths, and an acoustically transparent lining disposed between the baffles of each device along the said zig-zag paths to stream-line the flow of air therealong, the separation of the baffles of each device from one another corresponding substantially to the half-wavelength of intermediate sound frequencies of the said band of frequencies in order to attenuate the said intermediate frequencies.

24. An apparatus as claimed in claim 23 and in which the transverse spacing between the said longitudinally extending sound-absorbing devices is from about 2 to about 6 feet, and the separation of the baffles of each device from one another is from about 4 to 12 feet.

References Cited in the file of this patent

UNITED STATES PATENTS

701,496	McKinnie	June 3, 1902
1,658,402	Warth	Feb. 7, 1928
1,821,688	Bourne	Sept. 1, 1931
1,963,341	Weber	June 19, 1934
1,998,386	Powell	Apr. 16, 1935
2,233,966	Tominaga	Mar. 4, 1941
2,270,825	Parkinson et al.	Jan. 20, 1942
2,271,892	Bourne	Feb. 3, 1942
2,297,046	Bourne	Sept. 29, 1942
2,519,161	Tucker	Aug. 15, 1950
2,704,504	Wilkening	Mar. 22, 1955

FOREIGN PATENTS

285,604	Great Britain	Feb. 23, 1928
746,961	France	June 9, 1933