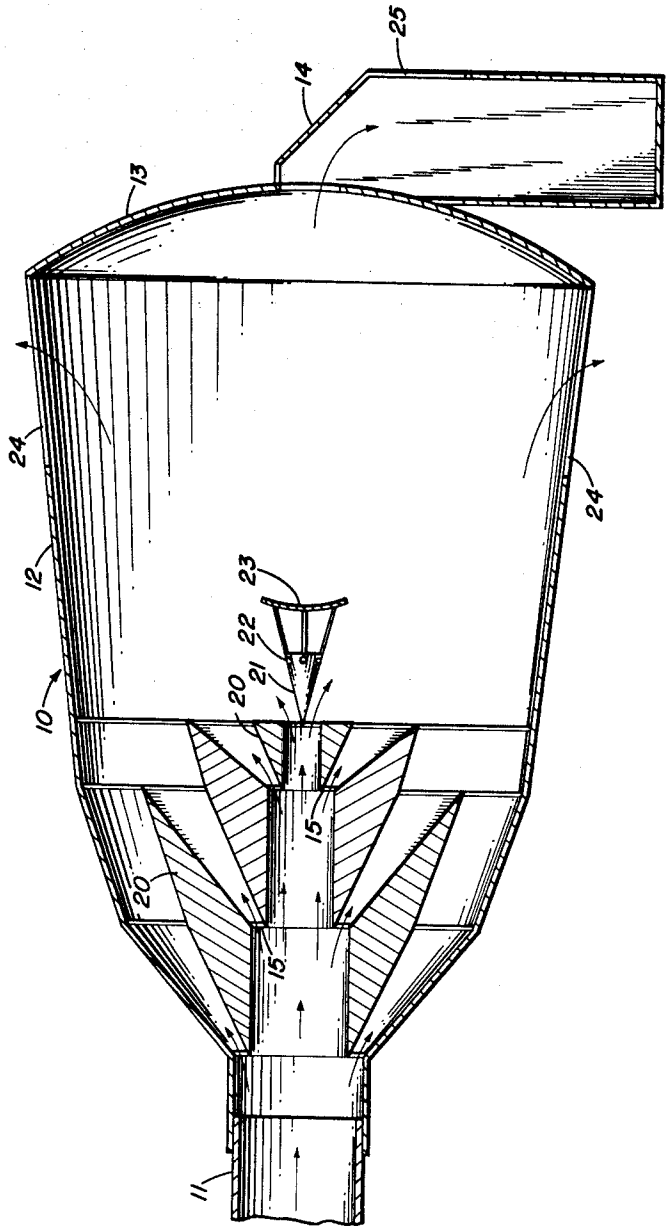
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PORTABLE SOUND SUPPRESSOR FOR AIRCRAFT JET ENGINES

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PORTABLE SOUND SUPPRESSOR FOR AIRCRAFT JET ENGINES

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The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

The present invention relates to a method of and apparatus for reducing the noise and heat of the exhaust from jet engines while being operated on the ground and more particularly to a method and apparatus for reducing the noise and heat of the exhaust from jet engines without the use of large sound chambers, water and the like.

It has been the practice to suppress the noise and heat of jet engine exhaust by the use of towers, water-spray tunnels and baffles. These devices are of such great size and bulk that their transportation from place to place is prohibitive. They are also restricted in their use with engines which are installed in aircraft and in portable test beds. Moreover, the large size of the above devices make them impractical as a part of a squadron's equipment.

Furthermore, the gas discharged from jet propulsion motors is usually at an extremely high temperature and conventional silencing means are likely to deteriorate rapidly under such conditions.

An object of the present invention is the provision of a method and apparatus for suppressing the noise and heat of the exhaust from jet engines while said engines are being operated on the ground.

Another object of the invention is the cooling of the discharge gases so that they will not destroy the means provided for silencing them.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawing wherein:

The single figure shows a cross-sectional view of a sound suppressor attached to the exhaust end of a jet engine.

Referring now to the drawing there is shown a sound suppressor **10** attached to the exhaust end of a jet engine **11**. The jet engine sound suppressor is comprised of a frusto-conical shaped housing with increasing diameter formed by an outer shell **12** and a surface of a spherical segment forming a large concave reflector **13**. Attached to the outer periphery of the reflector **13** is a sound chamber **14** the purpose of which is to be described hereinafter. Within the sound suppressor **10** is a series of nozzles **15**, said nozzles being formed by annular-shaped nozzle dividers **20** mounted by brackets (not shown) on shell **12**. Each of the nozzle dividers is different in cross-sectional area, said section being taken through the longitudinal axis of shell **12** and said longitudinal axis lying within the sectional plane, and shaped so as to provide a different size nozzle between each of said dividers. The nozzles decrease in size as their distance from the intake end increases and are concentric with the horizontal axis of the sound suppressor. The smallest divider **21** has a plug center about which is mounted a series of whistles **22**. The whistles are so arranged that the sound waves radiate in a plane normal to the longitudinal axis of the sound suppressor housing **12**. As stated above, the nozzles have different configurations so that the sound emanating from each of said nozzles will be of a different pitch. Located aft of the exhaust opening **11** and in line with said opening there is mounted a sound reflector **13** which reflects the sound waves back towards the nozzles. The outer shell **12** having a constantly increasing diameter, the maximum diameter reached at the reflector **13** is such as to enable the suppressor **10** to handle the volume of the exhaust at or near atmospheric pressure. The reflector **13** is sufficiently large to eliminate substantially all of the sound waves emerging from the nozzles. However, a small concave reflector **23**, having its concave surface facing the concave surface of reflector **13**, is provided to concentrate the remaining sound waves and which in turn directs the sound waves into a sound absorbing chamber **14**, where the wave-free exhaust gas may be emitted through exit **25**.

The sound suppressor described above operates in the following manner: The hot exhaust gases of the jet engine are directed through the series of nozzles **15**, each nozzle taking off the outer layer of hot gases. As the gas passes through each nozzle, it is expanded to near atmospheric pressure as it approaches the outer shell **12**. During the expansion process, the temperature of the gas is reduced and the sound is reduced in pitch. Each of the nozzles **15** being of a somewhat different configuration, sound waves will be emitted of a different and non-compatible frequency from each of said nozzles. As the sound waves pass over the last nozzle, they encounter the wall of sound waves being emitted by the whistles **22**, thus tending to destroy the sound waves attempting to pass through the nozzles. The sound waves which finally emerge from the exhaust of the suppressor are picked up by the reflector **13** and directed back into the unit. The reflector **13** is so curved that the sound waves reflected are returned and concentrated on a reflector **23**. The reflectors separate the sound waves from the air stream and from reflector **23** substantially all of the sound waves pass through a sound chamber **14**, the sound chamber being filled with a sound absorbing material. Not having an air blast to carry the sound waves out of the chamber, the waves beat themselves out on the soft interior of the chamber. The exhaust gases, which are at this point near atmospheric pressure and at greatly reduced temperature and substantially free of sound waves, are then free to leave the suppressor at the exits **24** and **25**.

Thus, the noise and heat created by the exhaust gas of jet engines is greatly diminished by the cooling and expansion of the gases through the use of expansion nozzles and the reduction in amplitude of sound waves by the algebraic summation of the various frequencies. These various frequencies are set up by the various configurations of each of the nozzles and a whistle **22**. Lower temperatures, a low velocity gas, and incompatible sound waves are set up by the use of the above described suppressor, thereby prohibiting the resonance of the surrounding structure and resulting in the reduction in the intensity of the sound emitted.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. Apparatus for reducing the heat and noise created

by the exhaust gases of jet engines, said apparatus comprising an outer shell having an expanded surface of increasing diameter moving outwardly and formed symmetrically about a longitudinal axis, said shell forming a cylindrical pipe at its smallest diameter for insertion over the exhaust pipe of an engine and bounded at its largest diameter by a surface of a spherical segment forming a reflector inwardly concave relative to said shell, said shell having a series of openings adjacent said reflector for permitting the escape of exhaust gases, a plurality of annular shaped dividers positioned concentrically about the longitudinal axis of said shell, each of said dividers being of a different longitudinal cross-section through said longitudinal axis and spaced from each other so as to form nozzles between said dividers, a smaller second reflector having a concave surface mounted centrally of said shell between said dividers and said first named reflector and having its concave surface facing the concave surface of said first-named reflector, whereby exhaust gases entering said apparatus will pass through said nozzles to said first reflector and deflected to said second reflector to create sounds of various frequencies and thus tend to negate jet engine noise.

2. The apparatus of claim 1 further comprising a cone-shaped divider mounted centrally of said shell between said dividers and said second name l reflector, and having a plurality of holes therein for producing a high frequency sound.

3. Apparatus for reducing the heat and noise created by the exhaust gases of jet engines, said apparatus comprising an outer shell having an expanded surface of increasing diameter moving outwardly and formed symmetrically about a longitudinal axis, said shell forming a cylindrical pipe at its smallest diameter for insertion over the exhaust pipe of an engine and bounded at its largest diameter by a spherical reflector inwardly concave relative to said shell and having a series of openings adjacent said reflector for permitting the escape of exhaust gases, a plurality of annular shaped dividers positioned concentrically about the longitudinal axis of said shell, each of said dividers being of different cross-section and spaced from each other so as to form nozzles between said dividers, a cone-shaped divider mounted centrally of the shell and having a plurality of holes therein for producing a high frequency sound, a smaller second reflector having a concave surface, mounted centrally of said shell and adjacent said cone-shaped divider, said second reflector having its concave surface facing the concave surface of said first-named reflector, a sound-absorbing chamber mounted on the exterior convex side of said first-named reflector, whereby sound waves directed from said first reflector are deflected to said second reflector and thence to said chamber whereby the sounds emanating from an engine exhaust are substantially diminished.

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