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ULTRASONIC SILENCER FOR JET ENGINES

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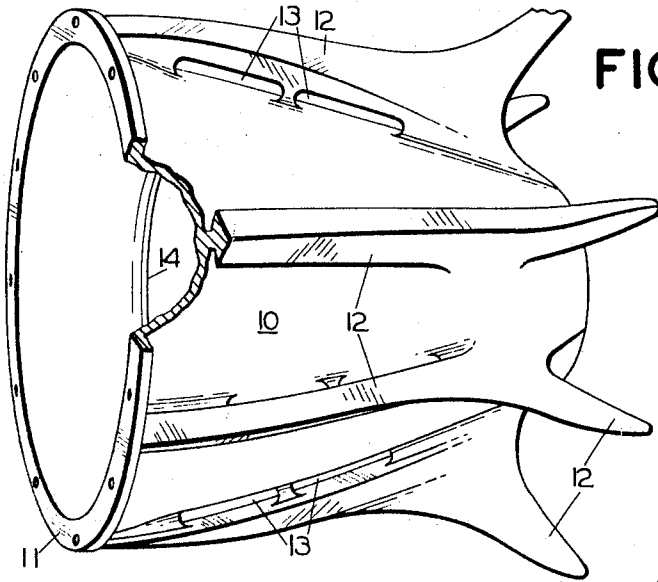


FIG. 1

FIG. 3

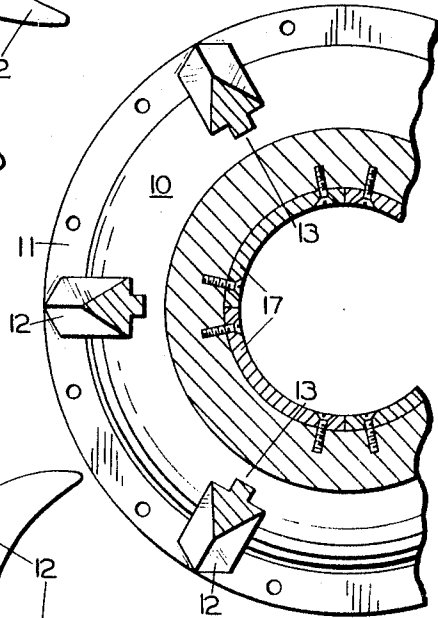


FIG. 4

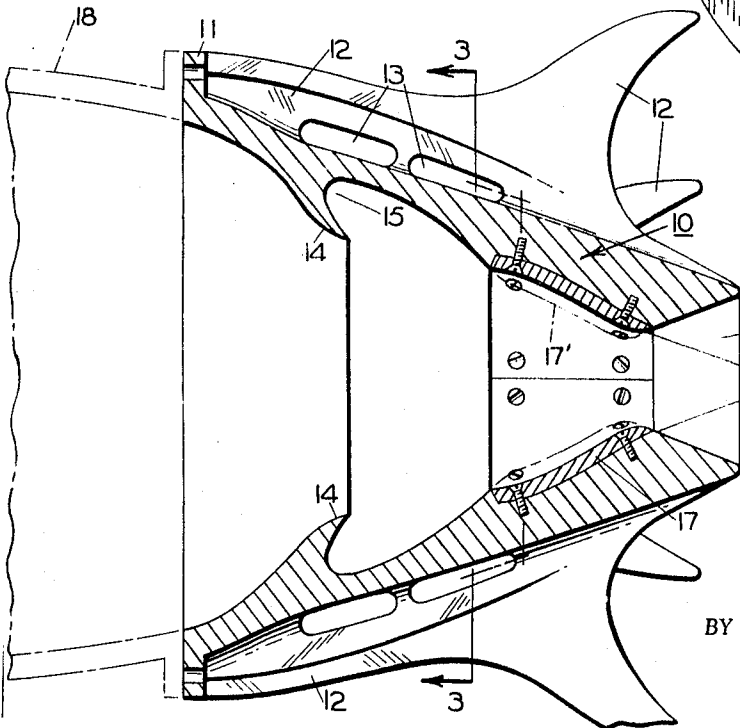
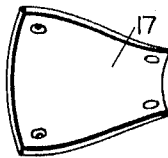


FIG. 2

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ULTRASONIC SILENCER FOR JET ENGINES

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6 Claims

ABSTRACT OF THE DISCLOSURE

A device for overcoming the noise from a jet engine by which the sound vibrations emitted from the jet engine have their frequencies increased to such extent that the resulting high frequencies of the sound vibrations finally discharged will be ultrasonic or beyond the range in which they can be detected by the human ear.

BACKGROUND OF THE INVENTION

The noise from jet engines is a well-known source of disturbance and annoyance in civil life to persons located within sounding distance of jet airplanes, and the noises of the jet engines on jet aircraft employed in war make detection by the enemy of the approach of such aircraft easier.

While various means have been developed and employed for deadening or partially absorbing other objectionable sounds at their source, such means have not appeared to be practicable or feasible for use in the case of noises emitted from jet engines.

It is well known that there is a range within which noise vibrations are detected by the average human ear and that noises comprising sound waves having frequency cycles below the low range limit or above the high range limit for the human ear become inaudible. Some animals are known to be able to detect sounds having such high frequency cycles that the same sounds are not audible to the average person. Special whistles have been developed for hunting which whistles are designed to produce sounds in the high frequency range for the purpose of attracting animals, the sounds in the high frequency or ultrasonic range being recognized by such animals as being beyond the range of sounds associated with and detectable by human beings. The present invention has been developed partially as a result of experimenting with and testing sound vibrations in the ultrasonic range.

SUMMARY OF THE INVENTION

The object of the present invention is to solve the problem of eliminating or reducing the noise from a jet engine. Instead of attempting to suppress the noise or to deaden or absorb the sound, the present invention provides a solution to the problem by increasing the noise or sound vibrations from the jet engine to such extent that the sound vibrations enter the ultrasonic range. This is accomplished by breaking up the wave cycles as they are emitted by the jet engine and forcing them to pass through a final outlet of such reduced size that the resulting increase in cycles brings them into the ultrasonic range.

BRIEF DESCRIPTION OF THE DRAWINGS

In the drawings:

FIG. 1 is a perspective view of an ultrasonic silencer designed in accordance with the present invention, a portion of the device being shown broken away for clarity;

FIG. 2 is a sectional elevation of the same taken along the center longitudinal axis of the device, the discharg-

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ing end of the jet engine on which the device is mounted being indicated by broken lines;

FIG. 3 is a partial section taken on line 3—3 of FIG. 2; and

FIG. 4 is an elevation of one of the sleeve insert segments adapted to be mounted in the discharging throat of the device.

Referring first to FIGS. 1 and 2, the device comprises a solid integral shell, more or less frusto-conical in shape, indicated in general by the reference character 10, having a large diameter intake end corresponding to the diameter of the discharging end of the jet engine. The shell 10 is formed of suitable lightweight alloy having high heat-resistance strength and is formed with a plurality, preferably six, of integral cooling fins 12 on the outside, preferably, but not necessarily, shaped as shown in the figures. Also preferably each integral fin has a pair of open longitudinal slots providing bridge portions 13 for promoting circulation of cooling air through the fins as well as along the fins.

The interior of the shell 10 is formed with an inwardly-extending annular lip or deflection ring 14, preferably having the cross sectional shape shown in FIG. 2. The lip of this deflection ring provides an annular recess or pocket 15 beyond the deflection ring. The wall of the pocket 15 also decreases rapidly in diameter and leads to the throat portion 16 of the shell. The interior diameter continues to decrease throughout the throat portion and, as the throat portion becomes more constricted and approaches its termination, it constitutes a "whistle section" from which the sound vibrations are discharged, leaving the device in an outwardly flared discharging mouth 19.

The shell 10 is formed with an exterior annular mounting flange 11 adapted to be bolted onto a companion flange provided on the discharging end of the jet engine (the discharging end of the jet engine being indicated in broken lines at 18 in FIG. 2). The diameter at the intake end of the shell is made to correspond to the diameter of the discharging end of the particular jet engine on which the ultrasonic silencer is used.

The effect of the contact of the sound vibrations with the deflection ring 14, and thence with the annular pocket 15 is to start the rapid build-up in the vibrations, and such build-up is thereupon greatly multiplied as the vibrations are driven through the constricting throat 16 with increasing greater concentration of force and increasing speed under the operation of the jet engine, until the number of sound cycles per second reaches the ultrasonic range as the exhaust is finally discharged from the throat 16.

The actual size of the throat opening should be determined by the thrust from the jet engine operating at a fadeout speed. During slower operation of the jet engine, thus while starting, idling or slowing down to a stop, the decrease in the number of sound cycles per second discharged from the throat would bring the resulting sound down into the audible range and produce the effect of a low whistle. The discharging end of the throat actually then does become the "whistle" section.

In addition to having the shell formed of high heat-resistant alloy, it is also desirable to cover the inside surface from the intake end at least to the end of the deflection lip 14 with additional anti-heat material, such, for example, as is used on the re-entry shield for spacecraft, in order to combat the heat of the immediate discharge from the jet engine.

The throat portion 16 preferably is lined with removable sleeve insert sections 17 as shown. Not only can these sections then be replaced when required, but, by using sleeves formed of sections of greater thickness, such as indicated in broken lines at 17' in FIG. 2, or by

adding further sleeve insert sections, the throat portion, and particularly the discharging end of the throat portion, can be made more constricting and be reduced to the extent necessary to insure that the sound vibrations, when finally discharged from the throat, with the particular jet engine to which the ultrasonic silencer is attached operating at a speed which will cause the vibrations to be of the high frequency necessary for the ultrasonic range.

I claim:

1. An ultrasonic silencer for a jet engine comprising a hollow body adapted to be mounted on the discharging end of the jet engine, said body having an intake end portion of maximum internal diameter corresponding approximately to the diameter of the discharging end of said jet engine and a discharging end portion of greatly reduced diameter, means in said body portion causing partial interference with the sound vibrations passing into and through said body from said jet engine, and a constricting throat in said discharging end portion of said body, the diameter of said throat being small enough to cause the sound vibrations driven through said body from said jet engine, when said jet engine is operating at such speed as to cause the sound vibrations to be multiplied sufficiently to bring said vibrations into the ultrasonic range as these are discharged from said body.

2. The ultrasonic silencer of claim 1 with said body being substantially frusto-conical and with integral cooling fins extending longitudinally on the outside of said body.

3. The ultrasonic silencer of claim 2 with said means in said body causing partial interference with the sound vibrations passing into said body comprising an annular lip extending inwardly in said body and an annular pocket behind said lip.

4. The ultrasonic silencer of claim 1 with said constricting throat lined with removable sleeve insert sections.

5. The ultrasonic silencer of claim 3 with said constricting throat so arranged as to have interchangeable composite sleeves mounted therein for the purpose of adjusting the minimum diameter at the discharging end of said throat.

6. The ultrasonic silencer of claim 1 with said means in said body causing partial interference with said sound vibrations passing into said body comprising an annular lip extending inwardly in said body and with an outwardly-flared mouth located directly beyond the minimum diameter discharging end of said constricting throat.

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181-61, 72; 239-127.1, 265.13, 265.15