A free-standing, ventilated, gas turbine exhaust silencer which effectively reduces both high-frequency and low-frequency noise emissions. The silencer is supported on a structural frame adjacent to the exhaust end of a gas turbine. Two low-frequency silencing sections are each mounted on the structural frame in such a manner that they are free to expand and contract with temperature variations in order to avoid thermal stressing. A HIGH-frequency section is supported by the upper low-frequency station. The weight of said silencing sections is transferred to the structural frame by ventilated tunnels which pass through the said low-frequency sections and act as structural beams.
3,704,762

1 GAS TURBINE EXHAUST SILENCER AND SUPPORT

BACKGROUND OF THE INVENTION

This invention relates, in general, to gas turbine exhaust silencers, and, in particular, it relates to a free-standing gas turbine exhaust silencer for the abatement of low-frequency and high-frequency noise emissions.

Prior art gas turbine exhaust silencers have largely consisted of acoustic parallel baffles mounted across the span of a gas turbine exhaust stack. These parallel baffles were generally high-frequency noise silencers and operated on the principle of noise absorption. As gas turbines have grown larger, it may be no longer feasible to employ parallel baffles within the exhaust stack because of increasing exhaust stack cross-section areas and increased temperature conditions. Further, silencing requirements have also become more demanding.

One problem associated with increased exhaust stack cross-section areas is that the parallel baffles must span the distance equal to one dimension of the cross-section area. Long spans mean increased weights and this becomes critical in the hot exhaust environment, where thermal fatigue, sag and buckling may occur. Since it is desirable to try to build silencers as cheaply as possible, the use of high-temperature alloys yields no solution because they are generally too expensive. Increasing cross-section areas of support members is also costly and undesirable.

As was already mentioned, the prior art solutions to gas turbine exhaust silencing have stressed high-frequency noise emissions and largely ignored low-frequency noise emissions. Parallel baffles are usually narrow in cross-section and more readily absorb high-frequency noise, whereas, low-frequency noise requires rather wide and deep silencing baffles.

Thermal expansion and contraction of the entire structure requires that the silencer structure be sufficiently flexible to prevent warping within the structure due to severe temperature gradients.

OBJECTS OF THE INVENTION

Accordingly, it is one object of the present invention to provide an improved gas turbine exhaust silencer which will be effective in attenuating, to acceptable standards, the increased noise levels of larger gas turbines.

It is another object of the present invention to provide a gas turbine exhaust silencer which will be responsive to attenuating both low-frequency and high-frequency gas turbine noise emissions.

Another object of this invention is to provide a free-standing gas turbine exhaust silencer which will protect structural components from thermal fatigue while allowing thermal expansion.

Still another object of the present invention is to provide an inexpensive and easily fabricated gas turbine exhaust silencer.

Other objects and advantages will become apparent from the following description of one embodiment of the invention, and the novel features will be particularly pointed out hereinafter in the claims.

2 BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially cutaway isometric view of the present invention, a gas turbine exhaust silencer.

FIG. 2 is an isometric view of the present invention, showing the manner in which acceleration batten are mounted within the structure according to the present invention.

FIG. 3 is a partially cutaway isometric view of one acceleration batten according to the present invention.

SUMMARY OF THE INVENTION

A gas turbine exhaust silencer supported by a free-standing structural frame adjacent to the exhaust end of a gas turbine. There may be two low-frequency silencing sections each comprising an acceleration section and an expansion section, and, one high-frequency silencing section comprising parallel baffles filled with acoustic absorption material. Each acceleration section includes box-like structures having acoustically absorbent exteriors around which gas flows. A plate and angle box means passes through the interior of each box structure for support. Since both ends of the box beam are open, ventilation of the support is possible if required. The weight of the silencer is transferred through each acceleration section to the structural frame, provision being made for thermal expansions.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to FIG. 1, of the drawing, there is shown a turbine enclosure for housing a gas turbine (not shown). The turbine enclosure is mounted adjacent to the gas turbine exhaust plenum which receives the hot exhaust gases from the gas turbine. An exhaust transition connects the gas turbine exhaust silencer, indicated generally at 11, with the exhaust plenum.

The outer structural support for the exhaust silencer is derived from a framework of flanged columns 15 and flanged beams 19 and 21 joined respectively at appropriate joints to the columns. Bracing members 25 may also be incorporated into the structure where necessary.

The flow path of the exhaust gases is indicated by the vertical arrows in FIGS. 1 and 2. From the exhaust transition, the hot exhaust gases are channeled into a lower acceleration section. The acceleration section is so-called because it comprises a number of acoustically absorbent acceleration batten 35 having adjacent sidewalls 37 forming gas passageways. These passageways must handle the same total volume of exhaust gas flow as is present in the exhaust transition. However, the cross-sectional area is much more limited and the gases are forced to accelerate through this section. The size and the spacing of the acceleration batten are specifically chosen so that the batten will be effective in substantially reducing low-frequency noise.

After the gases have passed through the lower acceleration section, they enter a lower expansion section wherein the gases are allowed to expand and some Kinetic head is recovered in static head. Low frequency noise is attenuated further, due to the large volume of the expansion section and corresponding decrease in gas energy. The expansion section is a large, hollow chamber having sheet metal sides 45 insulated on the interior side and braced on the exterior 25.
Thereafter, the gases pass through an upper acceleration section and an upper expansion section. Again, these sections attenuate primarily low-frequency exhaust sounds.

Mounted on top of the upper expansion section are a number of parallel baffles 51, similar to those described as prior art, altogether forming a parallel baffle section.

The acceleration batt 35 is shown best in FIG. 3, as a hollow acoustically prepared box structure through the center of which runs a box beam tunnel 61. The tunnel extends outward at each end of the batt to form a lip portion 63.

The lip portion 63 may rest freely on either beam 19 or 21 thereby allowing expansion to take place. The tunnel 61 is surrounded by fiberglass insulation which provides thermal insulation and acoustic absorption. The exterior portion of the batt is comprised of perforated sheet metal which may be stainless steel if circumstances warrant its use.

In terms of the silencer structure, a number of these acceleration batts are placed so that their sidewalls 37 lay adjacent one another, approximately nine inches spaced apart to form the passageways. The exhaust gas passes through the passageways formed by adjacent sidewalls 37 of the acceleration batts.

The tunnel 61 with lip 63 provides a main structural support element in the exhaust silencer. The weight of the silencer parts is transferred to the structural framework through the acceleration batts by means of the tunnel 61 and lip 63.

The tunnel also allows ventilation cooling indicated by horizontal arrows of the silencer particularly of the tunnel 61 itself. Ventilation may be natural or forced. Use of the tunnel construction allows the interior of the support to be ventilated while the exterior of the tunnel is thermally insulated. This allows the tunnel to be constructed of carbon steel instead of a high-temperature alloy.

Another unique feature of the construction is that the acceleration batts are freely laid, by means of the lip 63 onto support framework to reduce fabrication costs and allow for thermal excursions of the entire silencer structure.

**OPERATION**

The hot exhaust gases pass from the exhaust end of a gas turbine and are directed through the exhaust plenum and exhaust transition into the lower low frequency section comprised of an acceleration section and on lower expansion section. Low frequency noises are absorbed into the lower acceleration section and low frequency noise is attenuated through reduction in gas energy in the lower expansion section. This process is repeated in the upper low frequency section. Finally the gases pass through the high frequency section where the high frequency noises are absorbed into a parallel baffle section and then exhausted to the atmosphere.

While there is shown what is considered to be the preferred embodiment of the invention, it is of course understood that various other modifications may be made therein and it is intended to cover in the appended claims all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A gas turbine exhaust silencer for use in a hot exhaust gas path of a gas turbine including a skeletal structural frame providing opposing structural elements;

2. A plurality of acoustically insulating boxes, each having a tunnel support member passing therethrough, and each supported by said tunnel member upon said opposite structural elements;

3. Said acoustical boxes having lateral spaces therebetween forming gas passageways, whereby hot exhaust gases pass through said lateral spaces and noise is absorbed from the gas path into said acoustical boxes.

4. The gas turbine exhaust silencer as recited in claim 1 wherein each tunnel support member is thermally insulated from said hot exhaust gases.

5. The gas turbine exhaust silencer as recited in claim 1 wherein each tunnel support member is open at each end to allow a cooling air flow therethrough.

6. The gas turbine exhaust silencer as recited in claim 1 wherein each end of the tunnel support member is formed with a lip which may bear freely upon opposite structural elements.

7. A gas turbine exhaust silencer for use in a hot exhaust gas path of a gas turbine comprising:

   a skeletal structural frame proving opposing structural elements;

   an upper acceleration section including a plurality of laterally spaced apart acoustical boxes, each having a tunnel support member passing therethrough, and each freely supported by said tunnel member upon said opposite structural elements;

   an upper expansion section above said upper acceleration section and supported thereby; and, an upper baffle section supported by said upper expansion section and said upper acceleration section whereby the upper acceleration section, through said tunnel members, freely supports its own weight, the weight of the upper expansion section, and the weight of the parallel baffle section.

8. The silencer as recited in claim 5 wherein the skeletal structural frame is a self-supporting structure.

9. The silencer as recited in claim 5 wherein there is a lower acceleration section and lower expansion section, below and in communication with said upper acceleration and expansion sections; said lower acceleration section including a plurality of spaced apart acoustical boxes, each having a tunnel support member passing therethrough and supported by opposite structural elements; said lower expansion section supported by said lower acceleration section upon said opposite structural elements.

10. The silencer as recited in claim 7 wherein each end of the tunnel support member is formed with a lip which may bear freely upon opposite structural elements.