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[54] **VENTILATION APERTURE FOR SHIELDED ENCLOSURES**
6 Claims, 3 Drawing Figs.

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[56] **References Cited**
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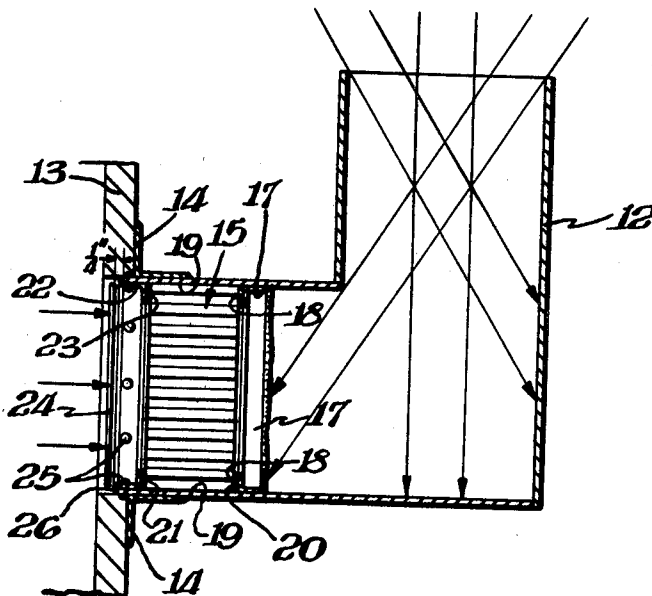
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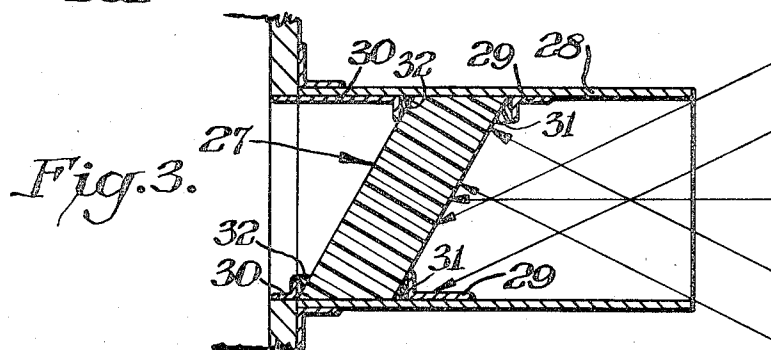
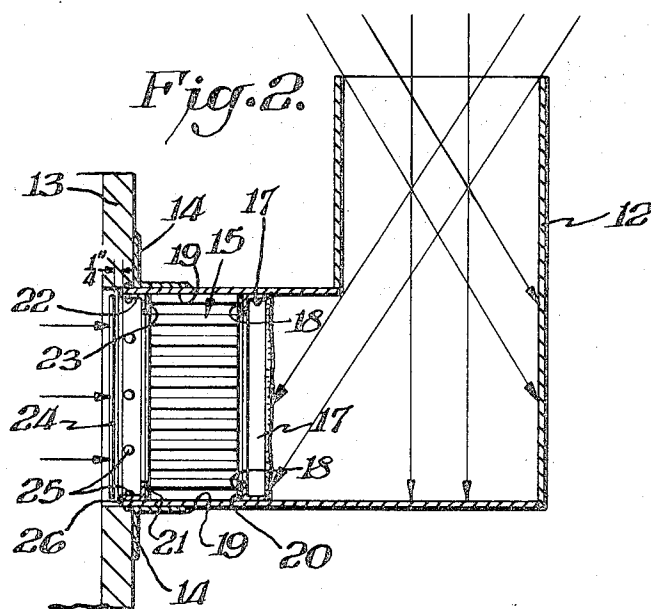
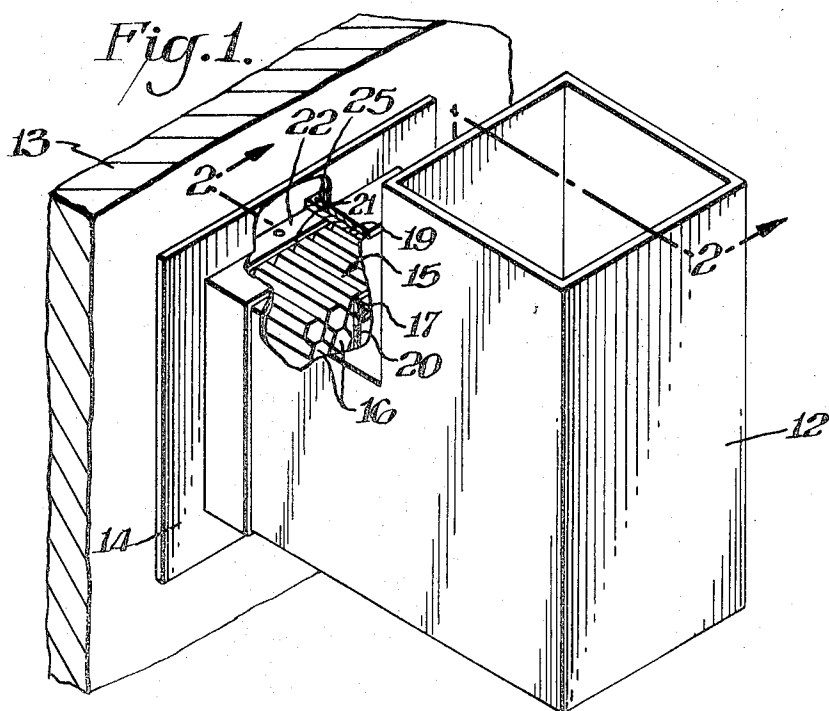
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ABSTRACT: A ventilation aperture for shielded enclosures is provided by a waveguide below cutoff grill placed within a magnetically shielded air duct housing. The grill is positioned within the housing by an improved sealing method so that positive electrical contact is maintained between the grill and the interior walls of the housing.





VENTILATION APERTURE FOR SHIELDED ENCLOSURES

BACKGROUND OF THE INVENTION

This invention relates to ventilation apertures for shielded enclosures and, in particular, to a waveguide attenuator grill operating below cutoff installed in a magnetically shielded housing attached to an opening in an enclosure wall.

Adequate ventilation for shielded enclosures introduces special problems in maintaining shielding effectiveness since openings must be made in an otherwise electromagnetically tight enclosure. The solution most favored in the past has been to fabricate a grill consisting of a series of hexagonal or square tubes continuously bonded together to form a honeycomb cross section and covering sufficient area to achieve the desired air flow. Each tube acts as an individual waveguide and can be designed with a diameter and length so that it will operate below a specified cutoff frequency and provide a specified degree of attenuation, respectively. This type of grill provides effective attenuation of electrostatic fields, plane waves and microwaves and, when used in combination with a specially designed angular housing attached to the enclosure, also provides attenuation of magnetic field excitation. The latter attenuation, however, depends in part, upon the quality of the seal between the waveguide and the interior walls of the housing. Present sealing methods call for tinning or brazing or the use of conductive epoxies. These methods are either very expensive calling for large dip facilities in the brazing case or subject to rupture (in the case of epoxies) with subsequent energy leakage and contamination.

It is therefore the principal object of this invention to provide a ventilation aperture for a shielded enclosure which provides attenuation for all forms of electromagnetic energy including improved attenuation of magnetic field excitation. It is a further object to provide a ventilation aperture comprising a waveguide below cutoff type grill sealed within a magnetically shielded housing.

It is a further object to provide a more effective and more economical method of sealing a waveguide grill to an air duct housing interior.

Summary of the Invention

In the broadest sense, the present invention comprises a waveguide below cutoff grill having improved connection means to the interior of a magnetically shielded housing. More particularly, the grill is located within the housing interior sandwiched between two angle frames connected to the housing. The actual contact areas are strips of resilient conductive material placed between abutting surfaces of grill and frame. The grill is forced into intimate contact with the contact material by pressure being applied to, and maintained against, one of the frames. The situation creates a positive electrical contact state between grill and housing and ensures that no energy leakage will occur.

In the preferred embodiment, the conductive material is a woven ferromagnetic mesh; the pressure is initially applied by a pressure pad operating against the edges of the outer frame. Pressure is maintained by rivets driven through housing wall and frame to hold the latter in the pressure position.

The installation procedure is simpler than any now being performed; a removal procedure is equally simple involving the drilling out of the rivets and abrading of a weld at the outer edge of frame and grill. Expensive tinning and brazing facilities are not required and there is no danger of later rupture of seams as is prevalent with epoxy solvents. The present invention thus adds to the versatility of the particular combination claimed and substantially lowers its construction costs.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the preferred embodiment of the invention comprising a waveguide grill situated within a magnetically shielded right angle housing;

FIG. 2 shows a cross section of the preferred embodiment taken along line 2-2 of FIG. 1;

FIG. 3 shows the cross section of an embodiment of the invention wherein the waveguide grill situated within a straight housing is set at angles to its walls.

DESCRIPTION OF THE INVENTION

Referring to FIGS. 1 and 2, housing 12 is formed as a right angle bend and is connected to enclosure wall 13 by plate 14.

The housing is preferably of ferrous construction with welded joints. Waveguide below cutoff type grill 15 is connected near one opening of the housing by means to be described below. The grill has a honeycomb core of seam-welded conductive material formed into a plurality of cells 16. Each cell is designed to operate below a cutoff frequency depending on the cell dimensions.

As can be seen in FIG. 2, magnetic field flux lines enter the mouth of the housing at random angles. Most of these flux lines will be intercepted by the duct walls and any stray magnetic flux lines deflected from the walls will be attenuated by grill 15 which is sufficiently displaced from the mouth such that there is no axial alignment with the core plane of the grill and hence no penetration. It is at this point that the quality of the connection of the grill to the housing comes into importance. A poor seal could alter the position of the grill and/or permit leakage through open areas of both R-F and magnetic energy. The improved method of sealing will now be described.

FIG. 2 shows a cross section of the housing to allow a closer examination of the mounting means used to connect the waveguide grill. Angle frame 17 is first placed into the housing a predetermined distance and seam-welded to the interior wall. The frame in the present embodiment is 1/8-inch thick iron with angled 1-inch surfaces. Surface 18 of the frame and surface 19 of the housing wall are grit blasted and then flame sprayed with a highly conductive, noncorrosive metal. These surfaces will be adjacent to the waveguide grill after it is installed. Gasket element 20, a 1/8-inch thick by 1-inch wide strip of woven ferromagnetic mesh is secured to, and extends around, surface 18 of the angle frame. Grill 15 is placed into the housing so that it rests against element 20. Another gasket element 21 of similar dimensions and properties as element 20 is secured to the periphery of grill 15. Angle frame 22 is then placed against element 21. The peripheral surface 23 of the frame can be blasted and sprayed as previously described.

As now assembled, the edge of the frame 22 should extend one-fourth inch past the edge of the housing. Dimensions of angle frames, gasket elements and waveguide grill should be known before hand and the grill positioned accordingly to obtain this projection. Using rectangular pressure pads 24 (or equivalent means) even pressure is applied in the direction of the arrows until the edge of frame 22 is flush with the edge of the housing. This pressure will be transmitted to gasket elements 20 and 21 and cause an effective, highly conductive seal between grill 15 and housing 12. While maintaining the pressure at pad 24, 1/2-inch holes are drilled through the housing and angle frame 22 and rivets 25 expanded into these holes and secured. These rivets can be any preferred "blind" type such as the "pop" or explosive head type. For the housing shown, a 3-inch space between rivets was sufficient to hold frame 22 rigidly in place. Pad 24 can then be removed. The clearance between frame 22 and the housing edge is then sealed by applying solder (or weld) 26. Angle frame 14 can now be welded to the outside of the housing completing the ventilation aperture assembly. The assembly can then be installed as shown in FIG. 1.

It is obvious that the dimensions of the angle frames will vary with the size of the housing used. However the dimensions of the gasket strip can be retained for most applications and the 1/4-inch travel of the last frame should provide sufficient sealant pressure. While woven ferromagnetic mesh yields good results as the gasket element, any other resilient conductive material could be used.

A feature of the invention is the relative ease of removing a grill from its housing mounting. Weld or solder 26 must first

be ground off rivets 25 drilled out, and frame 22 removed. Since there are no interior welds, the grill can be simply lifted out.

FIG. 3 shows a cross section of an alternate embodiment of the invention wherein a waveguide grill 27 is set at an angle within a straight housing duct 28. The housing must be of sufficient length such that any angle at which the magnetic lines of flux enter the mouth of the housing will be attenuated by the housing walls or the walls of the cells themselves. Frames 29 and 30, gasket elements 31 and 32 play the same role as frames 17 and 22 and strips 20 and 21 of FIGS. 2 and 3. The grill however is fastened so that while its cells are at an angle to the housing walls, its sides are flush against it. Also the gasket elements are wedge shaped to accommodate the angular "fit" of the grill. The pressure against the sealants can be brought about and maintained as previously described.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention it is to be understood that the invention is not limited to said details except as set forth in the appended claims.

I claim:

1. An improved ventilation aperture for use in a shielded enclosure wherein the aperture includes at least one waveguide below cutoff-type grill inserted within a magnetically shielded duct attached to the enclosure, the improvement comprising improved means for sealing the waveguide grill to the duct interior said means comprising:

- a waveguide below cutoff type grill positioned within the magnetically shielded duct;
- a first magnetically shielded frame member sealed within the inside periphery of the duct;
- a second magnetically shielded frame member positioned within the duct and spaced far enough apart from said first frame member to accommodate said waveguide grill between said members;

first and second resilient conductive elements sandwiched between the outside and opposing peripheral surfaces of said grill and the abutting surfaces of said first and second frame members; and

means for applying and maintaining uniform pressure against the free surface of said second frame member

whereby said pressure is transmitted to said first and second conductive elements resulting in close electrical contact between said elements and abutting waveguide grill and frame member surfaces.

2. An improved ventilation aperture as described in claim 1 wherein said first and second resilient conductive elements are strips of woven ferromagnetic mesh.

3. An improved ventilation aperture as described in claim 1 wherein a film of highly conductive, noncorrosive metal is sandwiched between said first and second resilient conductive elements and all surfaces abutting said strips.

4. An improved ventilation aperture as described in claim 1 wherein said means for applying and maintaining uniform pressure against the free surface of said second frame member comprise a plurality of retaining elements extending through both frame member and duct wall and serving to maintain the frame member stationary in a previously determined, pressure-applying position.

5. An improved ventilation aperture as described in claim 4 wherein said retaining elements are pop rivets.

6. An improved ventilation aperture for a shielded enclosure comprising: a straight magnetically shielded duct; a waveguide grill positioned within said shielded duct and inclined to a sufficient angle so as to prevent direct impingement on the grill core cells of magnetic lines of flux entering the outside end of said duct; a first magnetically shielded frame member sealed within the inside periphery of said duct; a second magnetically shielded frame member positioned within said duct and spaced far enough apart from said first frame member to accommodate said waveguide grill between said members; first and second resilient conductive elements sandwiched between the outside and opposing peripheral surfaces of said grill and the abutting surface of said first and second frame members with portions of said conductive elements being of wedge shape so as to offer a complementary inclined surface to the respective inclined grill surface and a vertical surface to said frames; and means for applying and maintaining uniform pressure against the free surface of said second frame member whereby said pressure is transmitted to said first and second conductive elements resulting in close electrical contact between said elements, the abutting waveguide grill and frame member surfaces.

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