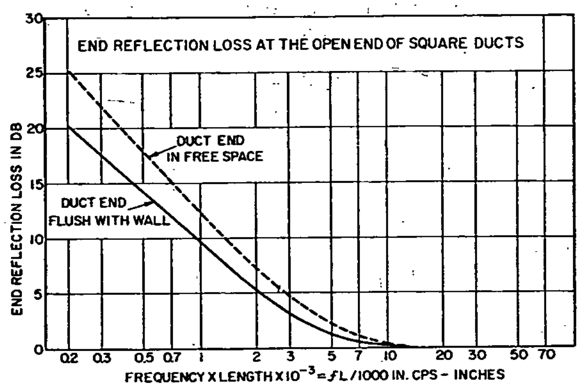

FIG. 9. END REFLECTION LOSSES IN DECIBELS AT THE OPEN END OF A SQUARE DUCT OF AREA L^2

The abscissa equals $fL/1000$ where f is the geometric mean frequency of an octave band in cps and L is the duct dimension in inches. Two cases are shown, with the duct end flush in the wall and with the duct end projecting into the room.

rock wool sheet. In Table 5 are listed the absorption coefficients of a material of this type in one-half and one-inch thickness.

It is also possible to calculate the absorption by a very complicated mathematical theory.[11, 12] Such calculations are in substantial agreement with Equation 22. This equation may be in error when applied to other types of duct lining and to duct sizes and shapes greater than those specified.

With every application, the use of sound absorptive material should be considered in the dual function of insulation and sound absorption. It has been shown theoretically that the reduction (in decibels per linear foot) of sound transmitted along a duct lined with sound absorbing material, is related in a rather complicated manner to the size and shape of the duct, to the frequency of the sound, and to the sound absorbing charac-

TABLE 5. ATTENUATION DATA FOR TYPICAL 1 IN. AND ½ IN. THICK DUCT LINING BOARD

Frequency Cycles Per Second	1-Inch Thickness			½-Inch Thickness		
	Absorption Coefficient α	$\alpha^{1.4}$	Attenuation db	Absorption Coefficient α	$\alpha^{1.4}$	Attenuation db
128	0.12	0.051	$0.64\ l\frac{P}{A}$	0.09	0.022	$0.28\ l\frac{P}{A}$
256	0.38	0.26	$3.2\ l\frac{P}{A}$	0.25	0.15	$1.9\ l\frac{P}{A}$
512	0.70	0.60	$7.6\ l\frac{P}{A}$	0.40	0.28	$3.5\ l\frac{P}{A}$
1024	0.80	0.73	$9.2\ l\frac{P}{A}$	0.72	0.63	$7.9\ l\frac{P}{A}$
2048	0.79	0.72	$9.1\ l\frac{P}{A}$	0.78	0.71	$8.9\ l\frac{P}{A}$

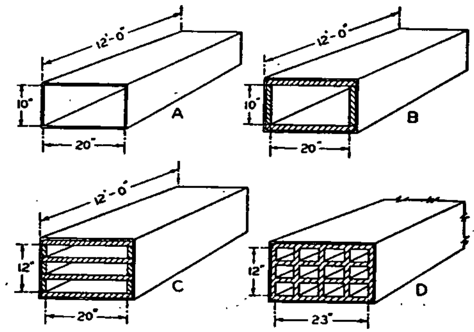

FIG. 10. ACOUSTIC TREATMENT OF DUCTS

A. Unlined metal duct.
B. Lined duct.
C. Splitter plate type absorber.
D. Cell type absorber.

The open area is the same for each case shown if 1-in. thick absorption material is assumed.

teristics of the lining. Experimental evidence likewise indicates that there is no simple formula involving the variables which will apply accurately to all cases. However, it may be stated generally that the attenuation in decibels at a given frequency is directly proportional to the length of lined duct. It decreases as the cross-sectional area increases, and increases as the aspect ratio is increased.

Rectangular Cells (Plate or Cell Absorbers)

If the available length of duct between the main duct (or the fan) to the grille is shorter than the length of lining indicated as necessary by Equation 22, the duct may be subdivided into smaller ducts as shown in Fig. 10, or it can also be even more subdivided by an egg-crate construction. In such a construction in which all the subdivided ducts are the same size, sound will be equally absorbed down each channel. It is, therefore, only necessary to calculate the sound attenuation of an individual channel. For this, Equation 22 is adequate, assuming that the thickness of the material is halved if it forms a common splinter between two cells.

When the number of splitter plates or cell partitions is large, the percentage free area of the gross duct size may be materially reduced. This leads to a further sound attenuation. Values of the attenuation possible, due to this cause, are given in Table 6.

Plenum Absorption

In systems where individual ducts are directed to a number of rooms, and sound treatment is required in every duct, a sound absorption plenum

TABLE 6. END REFLECTION OF PLATE OR CELL ABSORBERS

Percentage Free Area of Absorber	50	40	30	25	20
Attenuation db	1	2	4	5	6