grille and the average level in the room, leaving an effective level of 65 db in the room. Reductions of noise level ranging from 5 to 25 db through duct systems have been encountered without the use of sound absorbing linings and the drop from supply opening to average room level may vary from 5 to 20 db.

To determine whether to use the *noisy*, *average*, or *quiet* column in Table 3, in forming an estimate of the relative amount of noise generated by the system, the length of the untreated duct system and the number of bends or elbows or splitters should be considered, since the longer and the more complex the system, the more reduction of noise level will occur before the sound reaches the room grilles. Also the sound absorbing power of the room should be taken into account, since in rooms where there is a great deal of absorptive material, such as rugs, draperies, curtains and furniture, there will be a higher loss between the outlet grille noise and the average room level. The ventilating engineer will have to judge whether the conditions deviate from the typical.

TABLE 3. DATA FOR DETERMINING REQUIRED REDUCTION OF FAN NOISE IN DECIBELS

Room Noise Level, db	Reduction Required, db		
	Equipment		
	Noisy	Average	Quiet
15	60	50	40
25	50	40	30
35	40	30	20
45	30	20	10
55	20	10	0
65	10	0	0
75	0	0	0

Manufacturers' ratings on equipment should be considered in connection with the foregoing discussion. The quantity determined involves the noise level which will be produced in the room and the manufacturer's method of rating must be considered before allowances previously mentioned are accepted.

Further discussion of factors affecting equipment noise is given in Chapter 29, Fans.

Predicting Noise Levels

To use Table 3, proceed by consulting Table 1 and determine the probable noise level already existing in the room, and, as suggested, assume that this level is satisfactory for current practice. This gives a noise level in decibels and from Table 3 determine the value of the required noise reduction in the column corresponding to the noisiness of the equipment.

Example 1. A 10 x 20 in. duct is connected to a private office space in a quiet location. Determine the length of lining necessary to attenuate average fan noise satisfactorily, using a lining material of a type to which Equation 2 applies, and having an absorption coefficient of 0.40 at 256 cycles.

Solution: From Table 1 the noise level in this office will be 35 db. From Table 3 a reduction of 30 db will be required.

Transposing Equation 2,

$$L = \frac{R}{12.6 \frac{P}{A} a^{1.4}} = \frac{30}{12.6 \times \frac{60}{200} \times 0.40^{1.4}} = 29.6 \text{ ft}$$

The sound absorbent properties of duct lining are extremely important and materials which have coefficients as high as possible should be used. This is particularly true of the coefficients at the low frequencies. Only certain sound absorbent materials among those listed in various publications[9] will be found to be suitable for duct lining. In addition to a high sound absorbent coefficient a duct lining material should have a low surface coefficient of friction, high resistance to moisture absorption, and should be fireproof and vermin proof. A number of building codes now specify that any sound absorbent material used for duct lining shall have no fire hazard. There are no existing specifications on moisture

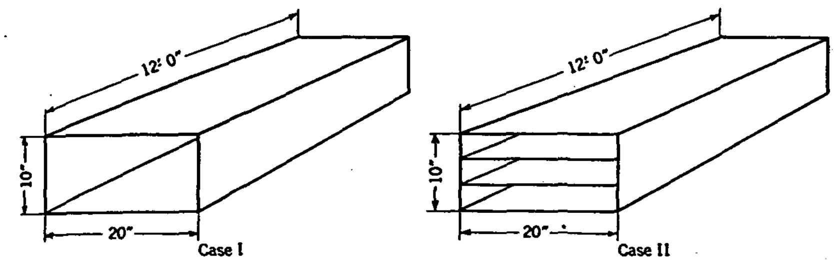

FIG. 2. DIAGRAM OF BRANCH DUCT TREATMENT WHERE LENGTH IS INSUFFICIENT FOR ADEQUATE ABSORPTION

resistance but the manufacturer should be required to show that the material will not absorb sufficient moisture to cause deterioration or to decrease the sound absorbing efficiency.

If, as is often the case, the length of duct from the main duct to a grille is shorter than the length of lining indicated by the calculations, this duct may be sub-divided into smaller ducts, as shown in Fig. 2. The increase in noise reduction thus obtained may be calculated from Equation 3, providing the splitters are installed parallel to the long side of the duct:

$$R_s = R_0 \frac{a + bn}{a + b} \tag{3}$$

where

R_s = reduction with splitters, decibels.
R_0 = reduction in same length of duct, without splitters, decibels.
a = dimension of short side of duct, inches or feet.
b = dimension of long side of duct, inches or feet.
n = number of channels formed by splitters.

[9]For coefficients of commercial sound absorbent materials see Bulletin *Acoustical Materials Association*, 919 No. Michigan Ave., Chicago, Ill.