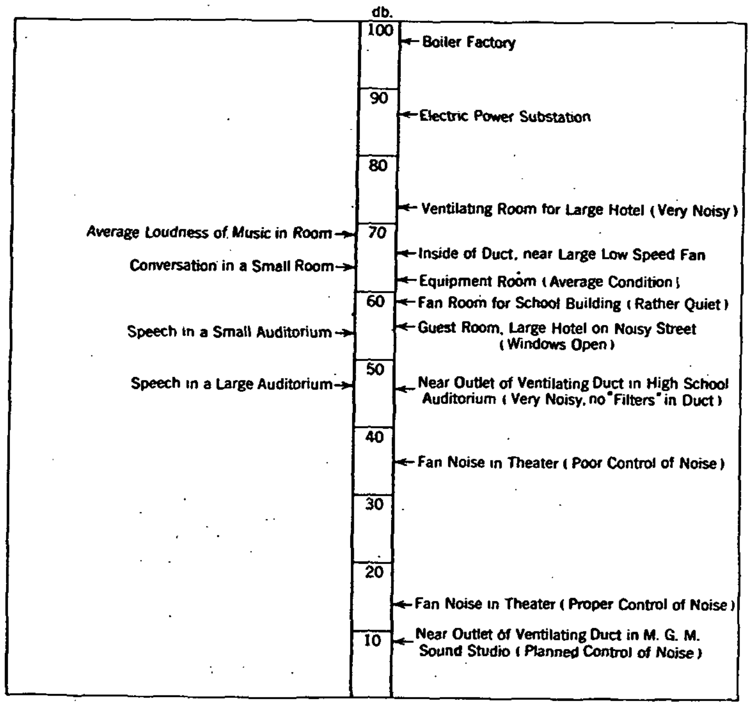

FIG. 1. CHART SHOWING THE EQUIVALENT LOUDNESS (IN DECIBELS) OF SPEECH, MUSIC, AND A NUMBER OF NOISES INCIDENT TO THE VENTILATING OF BUILDINGS[a]

[a]*Acoustical Problems in the Heating and Ventilating of Buildings*, by V. O. Knudsen (A.S.H.V.E. TRANSACTIONS, Vol. 37, 1931).

In every problem of noise reduction in buildings it is necessary to know how much noise can be tolerated. The noise levels given in Table 1 may be regarded as completely inoffensive. They represent what might be termed ideal conditions, not often realized in existing buildings. However, they represent conditions which can be attained by proper control

TABLE 1. ACCEPTABLE NOISE LEVELS

Talking Picture Studios	6 to 8 db
Radio Broadcasting Studios	8 to 10 db
Hospitals	8 to 12 db
Music Studios	10 to 15 db
Apartments, Hotels, Homes, Small Private Offices	10 to 20 db
Theaters, Churches, Auditoriums, Classrooms, Libraries	12 to 24 db
Talking Picture Theaters, Small Clothing Stores	15 to 25 db
General Offices	20 to 30 db
Large Public Offices, Banking Rooms, Upper Stories of Department Stores, Restaurants, Barber Shops	25 to 35 db
Grocery Stores, Drug Stores	30 to 50 db
Accounting and Typewriting Offices	35 to 45 db
Main Floor of Department Stores	40 to 50 db

of noise, and the heating and ventilating engineer should aim to provide the degree of quiet specified in the table.

In considering the tolerable room noise level due to heating, ventilating, or air conditioning apparatus, not only must the absolute value of the noise be considered but also its relation to the room noise level without the apparatus running. This is necessary since a large increase of noise subjects the apparatus to serious criticism even though the level may be low. It must also be borne in mind that the noise produced by the apparatus is additive to that of the room without apparatus. Thus if the two are equal, when combined the noise level will be 3 db higher. For these reasons the room noise caused by the apparatus should not exceed the other room noise.

Noise Control

Essential to the design of a satisfactory system are: *first*, a knowledge of the nature and intensity of the noise generated by the various parts of the equipment; *second*, a knowledge of how to vary the noise level between the apparatus and the conditioned room if need be; *third*, a knowledge of the acceptable level of apparatus noise in the conditioned room. Besides these, the engineer must be able to deal with other noises which might enter the room when openings are made into it, such as *cross talk* between rooms connected with common ducts, and noise transmitted to portions of duct systems outside the conditioned room and thence to its interior.

The problem of apparatus noise is receiving the study of equipment manufacturers who are aiming at both noise reduction and standardization. Some manufacturers now have noise ratings available for their equipment, while some pass each unit of equipment of certain types through sound tests during the course of manufacture.

The problem of noise reduction from apparatus to room must take into consideration and treat separately the three modes of travel of noise to the room: *first*, from the apparatus through the air to the walls of the room and thence to its interior; *second*, through the building structure to the room; *third*, through ducts or openings to the room. Because the noise entering by each of these three channels is susceptible to quantitative analysis, solutions are available. Along with the transmission of sound through the building structure, the engineer must also consider the transmission of vibration, which may also be objectionable. The solution is not complete, however, until the effect of the noise entering the room on the room noise level is determined.

ROOM NOISE LEVEL, COEFFICIENTS OF ABSORPTION

One of the most effective means of reducing noises in ventilating equipment is accomplished by the proper covering of the interior walls and ceiling of the equipment room, or the inner walls of the ducts, with sound-absorptive materials. The intensity I of a continuous sound in a room is

$$I = \frac{E}{a} \text{ or } \frac{I^1 S^1}{a} \qquad (2)$$

where

E = the rate of emission of the noise source = $I^1 S^1$. (The intensities of noises entering the room times the areas through which they enter).