exactly equal to that radiated into the room. The sound power absorbed per square foot of wall surface is equal to the incident intensity times the absorption coefficient. The total power absorbed by the walls, therefore, will be equal to the average intensity times $S\bar{\alpha}$, where S is the total surface area of the walls, ceiling, and floor and $\bar{\alpha}$ is the average absorption coefficient of the room. Equating the power absorbed by the walls to the power radiated into the room we can solve for the average intensity of the reverberant sound in the room:

$$\text{Reverberant intensity} \times S\bar{\alpha} = \text{transmitted intensity} \times S_w$$

$$\text{Reverberant intensity} = \frac{S_w}{S\bar{\alpha}}(\text{transmitted intensity}) \qquad (6)$$

Combining the reverberant and the transmitted sound will give the actual sound pressure in the secondary room. The difference in sound pressure levels on opposite sides of the partition is called the noise reduction and may be found with the aid of Figure 20. The horizontal axis of Figure 20 gives the ratio (S_w/S) of

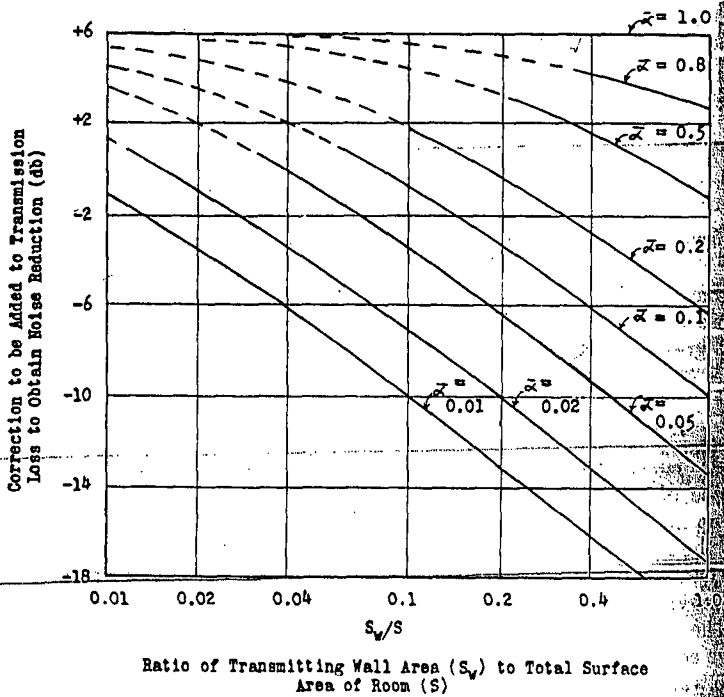

Figure 20. Curves for the calculation of the noise reduction between two rooms.

the transmitting area to the total surface area of the room. The point on the vertical axis corresponding to the intersection of the correct area ratio and the curve for the average absorption coefficient, $\bar{\alpha}$, gives the number of decibels that must be added to the transmission loss (Figure 18) to get the noise reduction.

Perfect absorption ($\bar{\alpha} = 1$) in the secondary room yields a noise reduction greater than the transmission loss. The reverberant condition in the source room causes the incident intensity level to be 6 db less than the sound pressure level (Section II.C), which gives rise to this difference. Since sound-measuring instruments react to the sound pressure rather than the sound intensity, one measures the noise reduction (difference in sound pressure level) rather than the transmission loss (difference between the incident and transmitted intensity levels).

The curves are dashed in the upper left-hand corner of Figure 20 to indicate they apply to the noise reduction measured near the partition. The levels in the remainder of the room are often less than near the partition.[10] When the radiating partition is relatively small (S_w/S small), it is often possible to use Figure 14 to find the level at locations away from the partition.

Examination of Figure 20 shows that one must have a certain amount of absorbing material in the secondary room in order to obtain the maximum benefit from an isolating partition. It should be noted, however, that there is a point of diminishing returns. It is economically wise, therefore, to add no more absorbing material than necessary to bring the level in the secondary room within a few decibels of that obtained for perfect absorption ($\bar{\alpha} = 1$).

K. A PRACTICAL EXAMPLE

Figure 21 shows a situation that lends itself to a demonstration of the use of Figures 12, 14, 18, 19, and 20. A small multislide machine that makes pins at the rate of about 300 a minute is fully automatic except for infrequent stoppages. The total sound power radiated by this machine is 80 mwatt (milliwatts), and the frequency distribution is similar to that shown for the weaving room (Figure 9). The sound power radiated in the 300 to 600 c.p.s. band is 10 mwatt. The sound pressure level in this band that exists in the right-hand room is to be computed.

First, it is convenient to replace the multislide machine by a hypothetical source radiating the same sound power, but spherical in shape and suspended in the center of the enclosure. If the area of the surface of this sphere is 1 square foot, the intensity there (at a radius $r = \sqrt{1/4\pi} = 0.28$ ft.) will be 10 mwatt per square foot. The corresponding intensity level is (see equation 3):

$$\text{Intensity level} = 10\log_{10}\left[\frac{10}{0.1}\;10^9\right] = 110 \text{ db}$$

The source is operating inside an enclosure in which the average absorption coefficient, $\bar{\alpha}$, of the wall is about 0.85 in the 300 to 600 c.p.s. band (Figure 12). The

[10] L. L. Beranek, *Acoustics*. McGraw-Hill, New York, 1954.