coefficient, α (alpha). An open window has an absorption coefficient of 1, whereas a piece of marble has an absorption coefficient very nearly zero.

The absorption coefficient, α, of most materials is not the same for all frequencies. This is especially true of the "acoustical materials," which are designed for high absorption. Figure 12 shows the absorption coefficient for several mate-

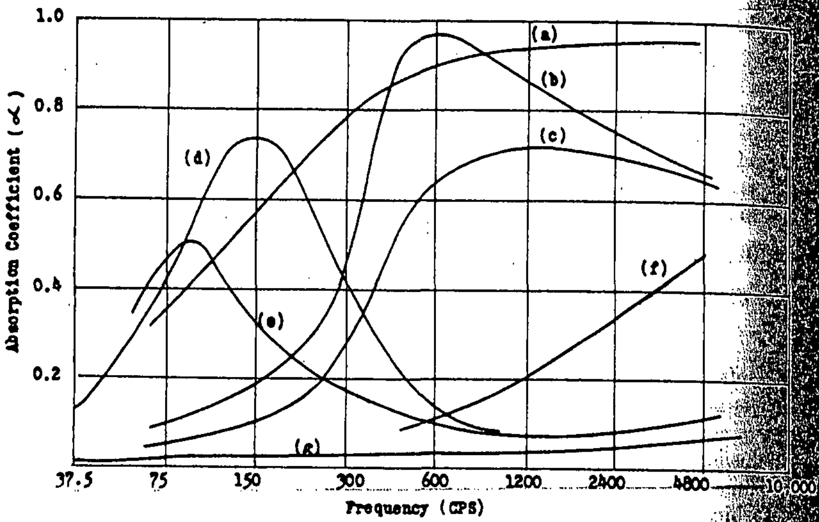

Figure 12. The absorption coefficient of various materials (a reverberant sound field is assumed): (*a*) 4-inch glass wool blanket (6 lb./cu. ft. density) against wall—no facing; (*b*) average for perforated acoustic tiles cemented directly to hard backing and 1 inch thick; (*c*) average for perforated acoustic tiles cemented directly to hard backing and $^1/_2$ inch thick; (*d*) 1-inch mineral wool blanket (Aerocor—2 lb./cu. ft.) covered by perforated facing (12 per cent open area) and separated from hard backing by 1-inch air space;[1] (*e*) $^3/_8$-inch plywood panel with 4-inch air space, one cross brace, and 2 inches of mineral wool at wall;[2] (*f*) heavy carpet on concrete;[4] (*g*) unpainted brick wall.[3]

rials in the audible frequency range. Published tables are available giving data on other materials.[5-7] There is no single ideal absorbing material; one must be chosen with characteristics that are best for the particular problem at hand.

The average absorption coefficient, $\bar{\alpha}$, of a room is a good indicator of the nature of the sound field within that room. One may calculate $\bar{\alpha}$ by multiplying α for each material in the room by the total number of square feet of wall surface that is covered by that material, adding all such products, and dividing the total by the surface area of the room. This computation is shown in equation 5.

$$\bar{\alpha} = \frac{S_1\alpha_1 + S_2\alpha_2 + S_3\alpha_3 + \ . \ . \ . \ .}{S_1 + S_2 + S_3 + \ . \ . \ . \ .} \tag{5}$$

Here α_1, α_2, α_3, and so forth, are the absorption coefficients of the various materials in the room and S_1, S_2, S_3, and so forth, are the surface areas of these materials, respectively. Naturally, the entire surface of the room including ceiling and floor should be accounted for in this calculation.

As an example, determine the average absorption coefficient, $\bar{\alpha}$, at 600 c.p.s., of a cubical room with 1-inch acoustical tile on the ceiling ($\alpha = 0.95$), brick walls ($\alpha = 0.03$), and a carpet on the floor ($\alpha = 0.37$). Since each side of the cube has an area equal to $^1/_6$ of the total area, the computation is as follows:

$$\bar{\alpha} = \frac{0.95l^2 + 0.37l^2 + 0.03\ (4l^2)}{6l^2} = 0.24$$

where l is the length of a side of the cube.

F. SOUND IN A ROOM WITH ABSORBING WALLS

When absorbing material is placed on the walls of a room, less sound is returned to the room after each reflection. The sound that is absorbed by the wall is transformed into heat and can never return to the room. If the walls of the room were perfectly absorbing the situation would be exactly the same as that shown in Figure 10 because there would be no reflected sound. If, however, some small fraction is returned to the room after each reflection, the sound field will be intermediate between the free field (Figure 10) and the reverberant field (Figure 11). An example of this intermediate situation is shown in Figure 13. The average absorption coefficient that has been assumed for this example is 0.9.

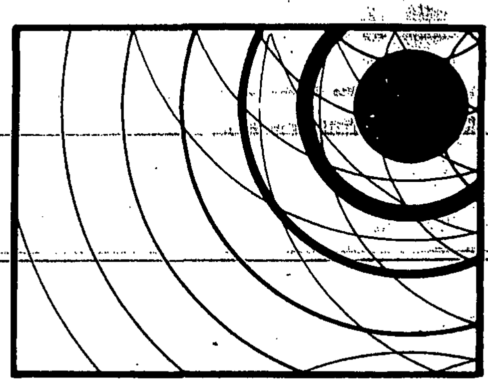

Figure 13. A graphical representation of the radiation of sound from a simple source in a room with absorbing walls.

[1] U. Ingard and R. H. Bolt, Absorption characteristics of acoustic material with perforated facings, *J. Acoust. Soc. Am.*, **23**, 533 (1951).

[2] ~~P. H. Parkin and H. J. Purkis, Sound absorption of wood panels for the Royal~~ Festival Hall, *Acustica*, **1**, 81 (1951).

[3] B. C. Purcell, private communication to the author.

[4] V. O. Knudsen and C. M. Harris, *Acoustical Designing in Architecture*. Wiley, New York, 1950.

[5] *Sound Absorption Coefficients of Architectural Acoustical Materials*. Acoustical Materials Association, 205 W. Monroe St., Chicago, Ill. (published periodically).

[6] Sound absorption coefficients of the more common acoustical materials, *Natl. Bur. Standards Bull.*, Letter Circular **LC 870**.