acoustics is the arbitrary value of 1 dyne/cm^2. In accordance with the equation

$$I = \frac{P^2_{\mathrm{rms}}}{\rho c} \tag{15.2}$$

this rms pressure corresponds to an intensity of

$$I = \frac{1^2}{153{,}500} = 6.5 \times 10^{-6}\ \mathrm{erg/cm^2 sec} = 6.5 \times 10^{-13}\ \mathrm{watt/cm^2}$$

which is typical of the intensities of the ambient noise backgrounds encountered in the sea. The reference level of 1 dyne/cm^2 will be used exclusively throughout this chapter.

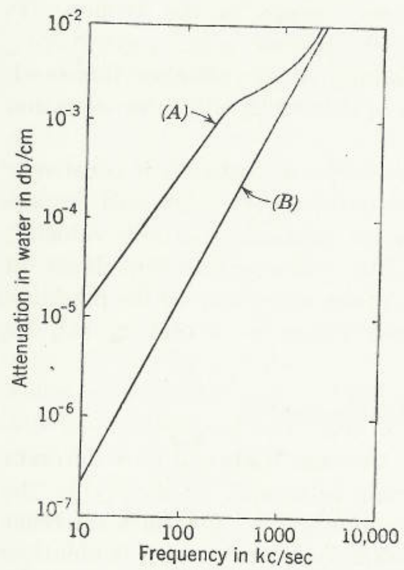

FIG. 15.1. Ultrasonic attenuation in water. (A) Sea water, (B) fresh water.

15.4 Attenuation of Sound in Sea Water. The measured attenuation of sound waves in fresh water, as given by equation 9.66b, is

$$I = I_0 e^{-2\alpha r} \tag{15.3}$$

where $\alpha = 24 \times 10^{-17} f^2$ neper per cm. This equation may be rewritten in the form

$$I = I_0 \times 10^{-ar/10} \tag{15.4}$$

where a represents the attenuation expressed in decibels per cm. Since $a = (20 \log e) \times \alpha = 8.7\alpha$, this attenuation constant is given by

$$a = 2.08 \times 10^{-15} f^2\ \mathrm{db/cm}$$

Curve B of Fig. 15.1 shows the manner in which the attenuation in fresh water varies with frequency. In the audio range below 10,000 cycles/sec this attenuation is less than 2.09×10^{-7} db/cm, or expressed differently, the attenuation is one decibel per 48 km, an entirely negligible amount. At a frequency of one megacycle per second the attenuation rises to one decibel per 480 cm and is no longer negligible.