

Industrial Noise

comes a disability only if defined as such by law. This is true of the term "occupational disease" also. We may be correct in saying that a loss of function is occupationally induced, but legally that loss of function need not be an occupational disease. What might be classed as an occupational disease or a disability in one state will not necessarily be so classed in another.

Most of the recent problems encountered in establishing equitable compensation laws for noise-induced hearing loss are a result of provisions declaring that occupational disease may be compensable. Hearing loss unquestionably reduces a man's capacity, but if the legal criteria used in many states for establishing disability are applied to noise-induced hearing loss, it is not legally a disability. While there is no date of injury or, in most cases, is there a loss of wages, there is no question that hearing loss can be occupationally induced.

Since the late 1940's, courts have frequently awarded financial compensation for hearing losses even though no specific date of injury could be shown and the claimant had suffered no wage loss, the standard benchmarks used since the laws were promulgated during the decade between 1910 and 1920. This increased emphasis on social loss caused by hearing impairment has put increased pressure on industry to worry more about conservation of hearing than compensation as a result of its loss.

The Ear and Hearing

Anatomy of the ear

The ear is among the most complex of the sensory organs. Its dynamic range of response is enormous. Sounds so faint they might well have been caused by the Brownian motion of molecules can be heard, and yet man can also hear without distortion sounds that are a million, million times more intense. Man also possesses the ability to distinguish some 300,000 tones of different frequency and/or intensity and to analyze complex sounds into their component parts.

The ear, that mechanism which is capable of such diversity, is a delicate, complicated structure. It is divided into three parts: the external ear, the middle ear, and the internal (inner) ear (Fig 45-1).

The external ear. The external ear acts as a conducting channel for sound. It is bounded outside by the auricle or pinna, and inside by the external layer of the drumhead or tympanic membrane, and consists of the auricle and the external auditory canal. This canal is about 25 millimeters long and is S-shaped. Sound waves traveling down this canal strike the eardrum.

The middle ear. Anatomically, the middle ear is bounded externally by the inner layer of the drumhead and internally by the mucous membrane which covers the bony wall just external to the inner ear. Within the middle ear cavity is a linkage of three ear bones or ossicles: the malleus (hammer), the incus (anvil), and the stapes (stirrup), and two small muscles. This linkage transmits the vibrations to the oval window—one of the five openings in the middle ear cavity.

The middle ear has three functions:

- It transmits energy from the sound vibrations in the air column of the external auditory canal, by means of the drumhead, ossicular linkage, and oval window, into the fluid contained within the cochlea (described under "inner ear"). It is apparent from the degree of hearing loss that exists when the drumhead and ossicular chain are not present in an ear, that vibrating air particles alone do not exert enough force on the oval window to transfer adequate amounts of acoustic energy to the cochlear fluid. The surface area of the drumhead plus the ossicular chain, however, with its attached muscles and ligaments, and the footplate of the stapes all act as a complex impedance-matching device effecting an efficient transfer of acoustic energy from airborne sound waves to sound waves in the fluid medium of the inner ear. (The flattened bony footplate of the stapes fits the oval window and acts as a hinge, allowing the stapes to move in trap door fashion. The round window is very small and is located below and in front of the oval window, and is covered by a thin membrane resembling the drumhead.)
- It protects the inner ear from the shock of intense sounds of low frequencies by the reflexive action of the middle ear muscles. These muscles tense the drumhead and ossicular chain thus reducing the amplitude of