Figure 5 is a plot of the radial stress (pressure) vs. time at the center of a man-sized head, midway out, and at the surface. The curves are computed for t_o = 10 microseconds and are normalized to I_o = 1000 mw/cm^3. The maximum acoustic pressure is about 4.7 dyne/cm^2. According to [22], the minimum audible sound pressure for bone conduction is about 50-60 db re 0.0002 dyne/cm^2 at frequencies between 5-10 KHz. At 60 db the sound pressure is about 0.2 dyne/cm^2. This pressure will require an absorbed energy of 42.5 mw/cm^3 at the center of the 7 cm radius head. From Figure 2, it is seen that 1 mw/cm^2 of incident power will induce a peak absorbed energy of 0.46 mw/cm^3. If we assume I_o is given by 80% of this value, we have for each mw/cm^2 incident an absorbed energy of 0.37 mw/cm^3. Consequently, these initial calculations predict a minimum incident power density of 115 mw/cm^2 at 918 MHz for pulsed microwave-induced hearing in humans. This compares favorably with the report [3] indicating that the peak power required for perception is around 80 mw/cm^2 at 1245 MHz.

The acoustic pressure in the head of a small animal such as a cat exposed to 2450 MHz radiation is shown in Figure 6. The maximum acoustic pressure at the center of the sphere is 2.3 dyne/cm^2. Figure 1 indicates a value of I_o = 1.36 mw/cm^3 for one mw/cm^2 of 2450 MHz radiation impinging on a 3 cm radius sphere. Assuming that the bone conduction threshold for cats is the same as for humans, our theory predicts a minimum incident power density of 64 mw/cm^2. There are two series of threshold measurements reported in the literature that may be compared to the above results. In one of these reports [4] the threshold for a 10 microsecond pulse was given as 2000 mw/cm^2. In the second [8], the measured threshold was 1300 mw/cm^2. The obvious difference between the measured and predicted thresholds could be due to the small sample size. It should also be emphasized that the thresholds predicted using a sphere may differ considerably from measured results because of the complicated shape and composition of the head.

SUMMARY

A mathematical model for acoustic response of humans and animals exposed to pulsed microwave radiation has been presented. Explicit expressions have been obtained for the frequency, displacement and pressure associated with the microwave-induced sound. Initial numerical results are given for a cat-sized spherical head exposed to 2450 MHz radiation and a man-sized spherical head exposed to 918 MHz radiation.

ACKNOWLEDGMENT

This work was supported in part by National Science Foundation Grant ENG 75-15227. I thank P.M. Nefcy and C.K. Lam for their assistance.

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