ELECTRONOTES

WEBNOTE 43 9/28/2016

ENWN-43

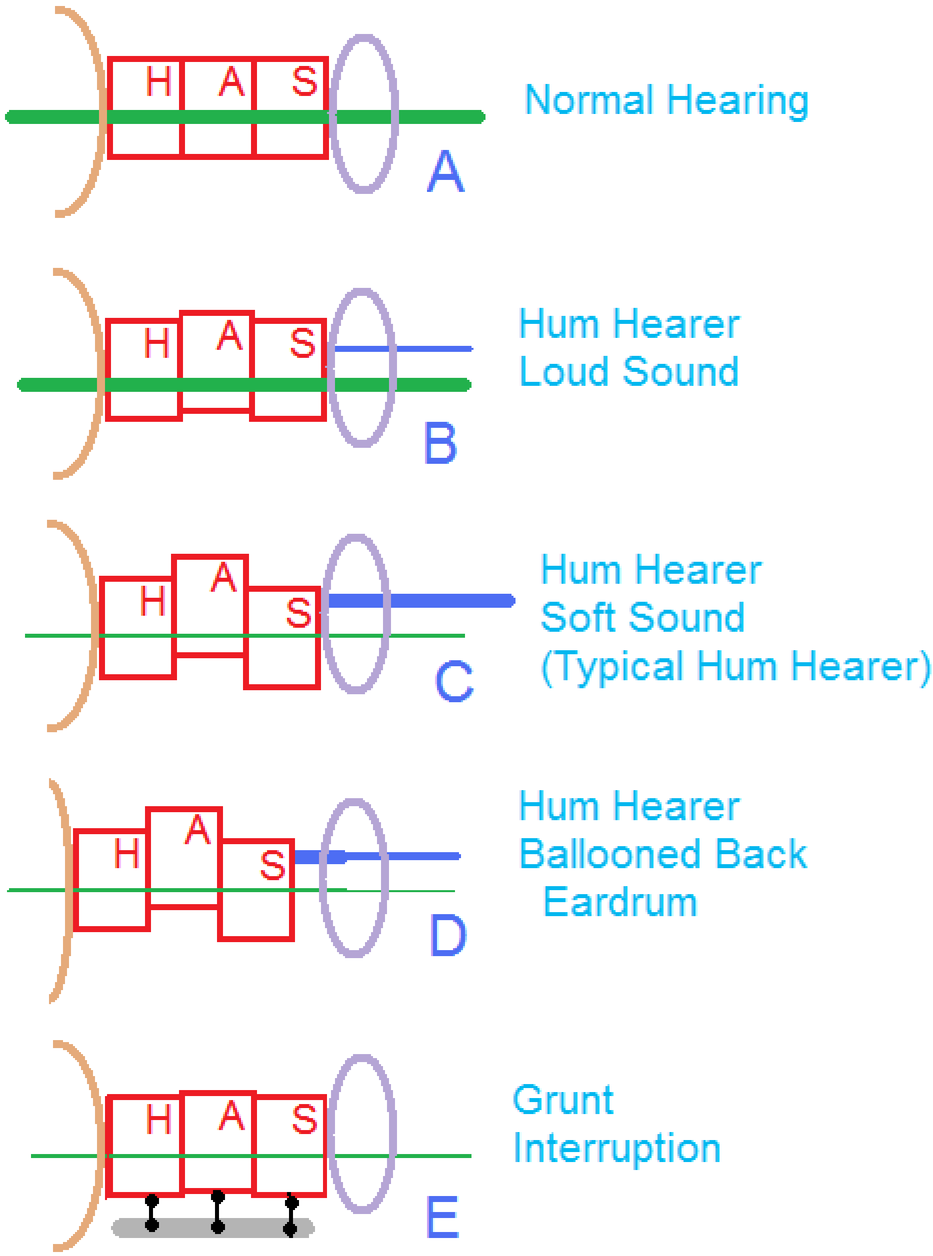
INTERRUPTION OF THE HUM - SPECULATION

In the highly schematic diagram on the next page, we suggest the middle ear (three red boxes), an air-filled chamber that may or may not have the same pressure as the outside atmosphere. The H-A-S chain is the famous Hammer-Anvil-Stirrup bones that match the impedance of the air (outer ear/ear-canal/eardrum) to the fluid in the cochlea (inner ear). The eardrum (in tan on the left) separates outer/middle while the “oval window” (purple on right) is the entrance to the cochlea. Green lines represent normal (acoustic) sounds. Blue lines represent a presumed Hum.

In A we represent normal hearing. Then we will make a large assumption that the Hum is generated in the middle ear by some random but possibly resonant fluctuations. No claim of precise cause is offered here. This Hum generation is suggested in our schematics by the vertical displacements of the H-A-S boxes. Here we assume in A that there is no Hum.

In B we suggest the case of a “Hum hearer” for the case where the normal sound (speech, music, or incidental environmental) is large (green line). In this case, we suppose that the Hum component is masked first by the large desired sound, and perhaps also by some inhibiting protective mechanism activated by the large sound. The Hum hearer will not be aware of the Hum yet.

In C we have the case where we are in normal “hum hearing” mode. Simply the desired acoustic sound has become very small. At the same time, (perhaps) that agitation of the H-A-S chain has increased. In any case, the Hum is now heard by the individual and is not masked.



Two cases of interruption of the hum are shown next. In D we show an imbalance in the pressure of the middle ear relative to the outer ear. This is a discomfort typical of changing altitude or having a head-cold. We show here that this assumed overpressure has “ballooned” the eardrum leftward, and decreased the contact between stirrup and the oval window. We may want to conclude that the reversed ballooning could also make the transfer less than ideal. In this case, the normal Hum hearing is decreased.

(C to D – note the lines get narrower beyond the oval window. Both the normal sound and the Hum are attenuated. "Popping" he ears (swallowing, etc) may restore (for an extended period) pressure equality, and be an apparent increase in loudness to both.

[We note in D that if the Hum were external, we would have the same result beyond the oval window. Hence a finding that there is no acoustical Hum in the air is important in interpreting the result here. Experiments show no acoustical counterpart to a perceived Hum.]

In E we have a different Hum interruption mechanism typically obtained by "grunting" or other quick noise, or by a head shake. In such a case, the Hum goes away sharply and returns (ramps back up) in perhaps 1/2 second. This we suggest may well be caused by some protective mechanism "clamping" the inner ear (black ties), silencing the Hum generation (no blue), but quickly finding itself unnecessary, relaxing. At the same time, the green path of normal sound is maintained. In fact, the experiment showed that even an artificially generated acoustic sound, closely mimicking the Hum in amplitude and frequency, was not interrupted.

-Bernie Hutchins, Aug. 23, 2016

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Here is a good graphic reference on the protective mechanisms of the middle ear.
http://hyperphysics.phy-astr.gsu.edu/hbase/sound/protect.html