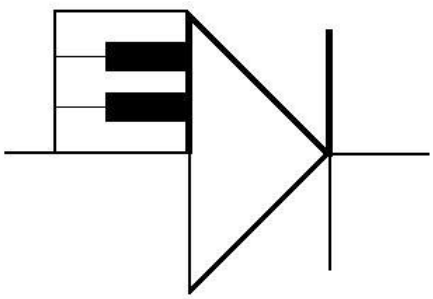


ELECTRONOTES

WEBNOTE 41 6/18/2016

ENWN-41

BRIEF INTERRUPTIONS OF "THE HUM"

Previously I posted five Webnotes concerning "The Hum", of which ENWN-40 was a summary:

[1] "Oh-Hum" , Electronotes Webnote ENWN-31, 2/13/2016, http://electronotes.netfirms.com/ENWN31.pdf

[2] "More on The Hum" Electronotes Webnote ENWN-37 4/08/2016 http://electronotes.netfirms.com/ENWN37.pdf

[3] "Notching to Try to Display 'The Hum' " Electronotes Webnote ENWN-38, 4/11/2016 http://electronotes.netfirms.com/ENWN38.pdf

[4] "Calculating/Measuring the Notch" Electronotes Webnote ENWN-39, 4/27/2016 http://electronotes.netfirms.com/ENWN39.pdf

[5] "Current View of My View of 'The Hum' ", Electronotes Webnote ENWN-40, 5/6/2016 http://electronotes.netfirms.com/ENWN40.pdf

The purpose of the addition here is to give the result of an obvious experiment, which I should have done before, concerning the interruption. So while I reported even in [1] that the Hum could be very temporarily knocked down by a grunt, by a headshake, or other interrupters, here I report that the same actions do NOT interrupt real audio in general, or the 50 Hz "simulation" of the Hum.

WHAT IS INTERRUPTION ABOUT?

My first encounters with the Hum were strange in that I could not find the “truck” or the “pump” that was causing it, and that it went on for hours/days, and that it had a nasty feature of evasion – like swatting at a fly. If you spoke or moved, the Hum ducked away only to rapidly return (see Fig. 1 below). I believe than others have reported this, although some may miss it unless careful observation is employed.

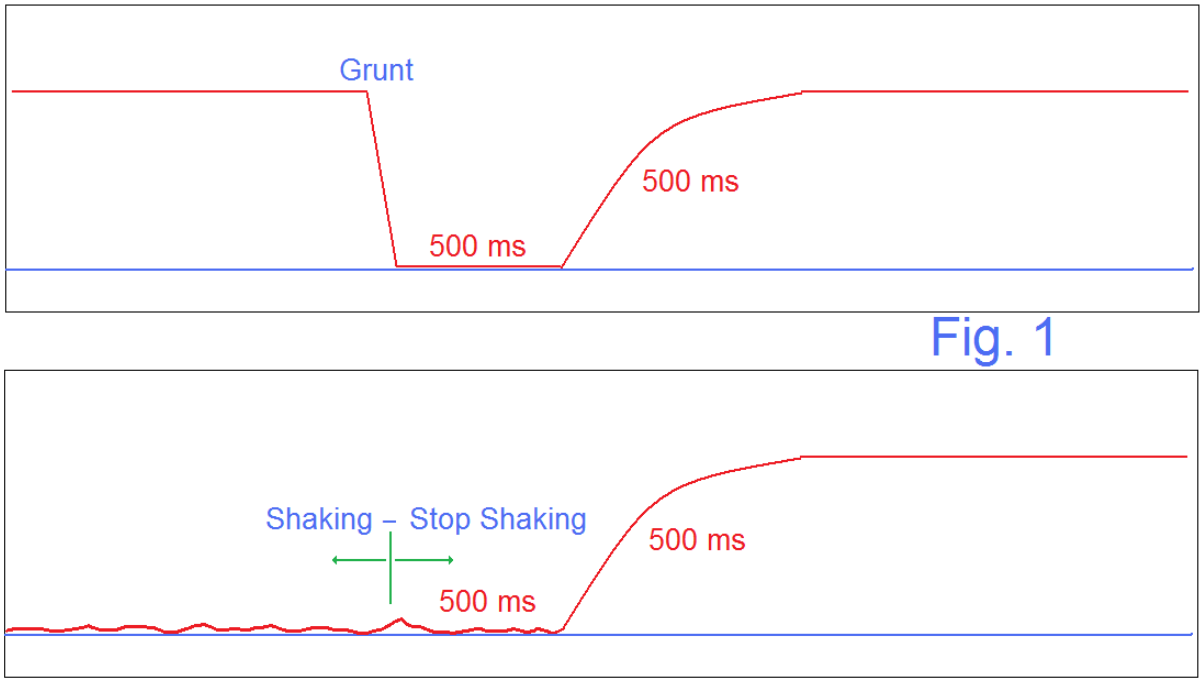


Fig. 1

Basically this seems to be a variation on the accepted theme that the Hum can be masked. [“Masked” is a term generally used in hearing when we find one sound is hidden by another. For example, a 1000 Hz tone, easily heard by itself, may disappear behind a somewhat louder tone at 1010 Hz.] It is widely acknowledged that the Hum disappears when environmental sound is normal (like ordinary noise during daytime) but may be heard well at night, until it is intentionally masked, like by running a fan. Here we are talking about short interruptions (less than about 1 second).

Fig. 1 shows how I hear these interruptions (rough sketches). The hum is going along nicely until I say something, or make a sharp grunt-like sound. (OR until someone else makes a sound.) The Hum drops abruptly to (or near to) zero, and then returns. On an ordinary time scale, it barely disappears. Mostly you hear the timely recovery, not so much the very short silencing. I estimate that it goes away for about

500 ms (half a second) and returns full after another 500 ms. This we can repeat as often as we wish. Fig. 1 (top) shows in red what would be considered the “envelope” of the Hum. Fig. 1 (bottom) is a variation where one avoids the distracting grunt (sound) by shaking one’s head. Think about how one shakes one’s head to signify “no”, and shake about twice this rate. This is imperfect although it can be carried out easily for perhaps 5 seconds, blocking the Hum. Note that the Hum recovers in the same manner (fully after 1 second) for both the grunt and the shake. There is no practical value as to hum relief by grunting or shaking – something like a running fan is most useful.

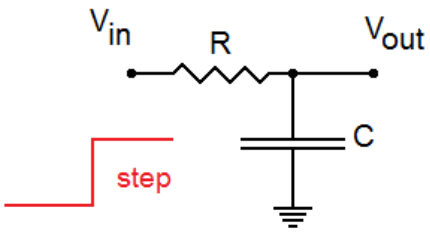
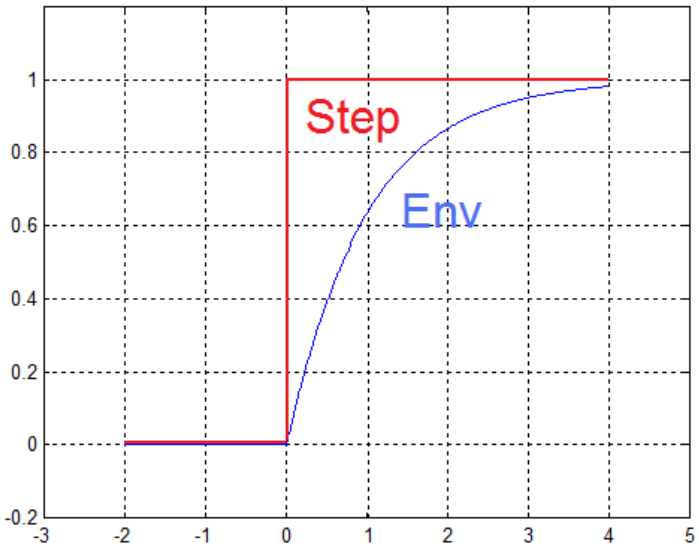


Fig. 2

Switching "Envelope"



I have drawn in Fig. 1 the recovery as a charging exponential as being a good approximation to what I hear. Fig. 2 reminds us that this is like a simple R-C circuit, the solution to many many first-order differential equations found in nature. Finding natural exponentials is not a surprise.

This interruption is not difficult to hear, but neither is it particularly easy to hear, because the “time constant” is short (say half a second). Recognizing that it is a repeatable phenomenon is a matter of concentrating, and repeating the test perhaps a dozen times.

The Hum can be interrupted by a grunt at the level of the individual hearer, and this is extremely significant. But first, another experiment.

WHAT EXPERIMENT AND WHY

What I did not do in my previous experiments was to <u>assure</u> that grunting, head-shaking, and the like, did not shut down aural perception in general (obviously not!) but specifically at a pitch level and amplitude level comparable to the Hum. That is, suppose that, yes, grunting interrupts the Hum. But does the grunting also perhaps interrupt a sound with amplitude and pitch (real sound) made to imitate the Hum?

<u>The answer is that NO, it does not.</u> <u>The interruption is specific to the hum.</u>

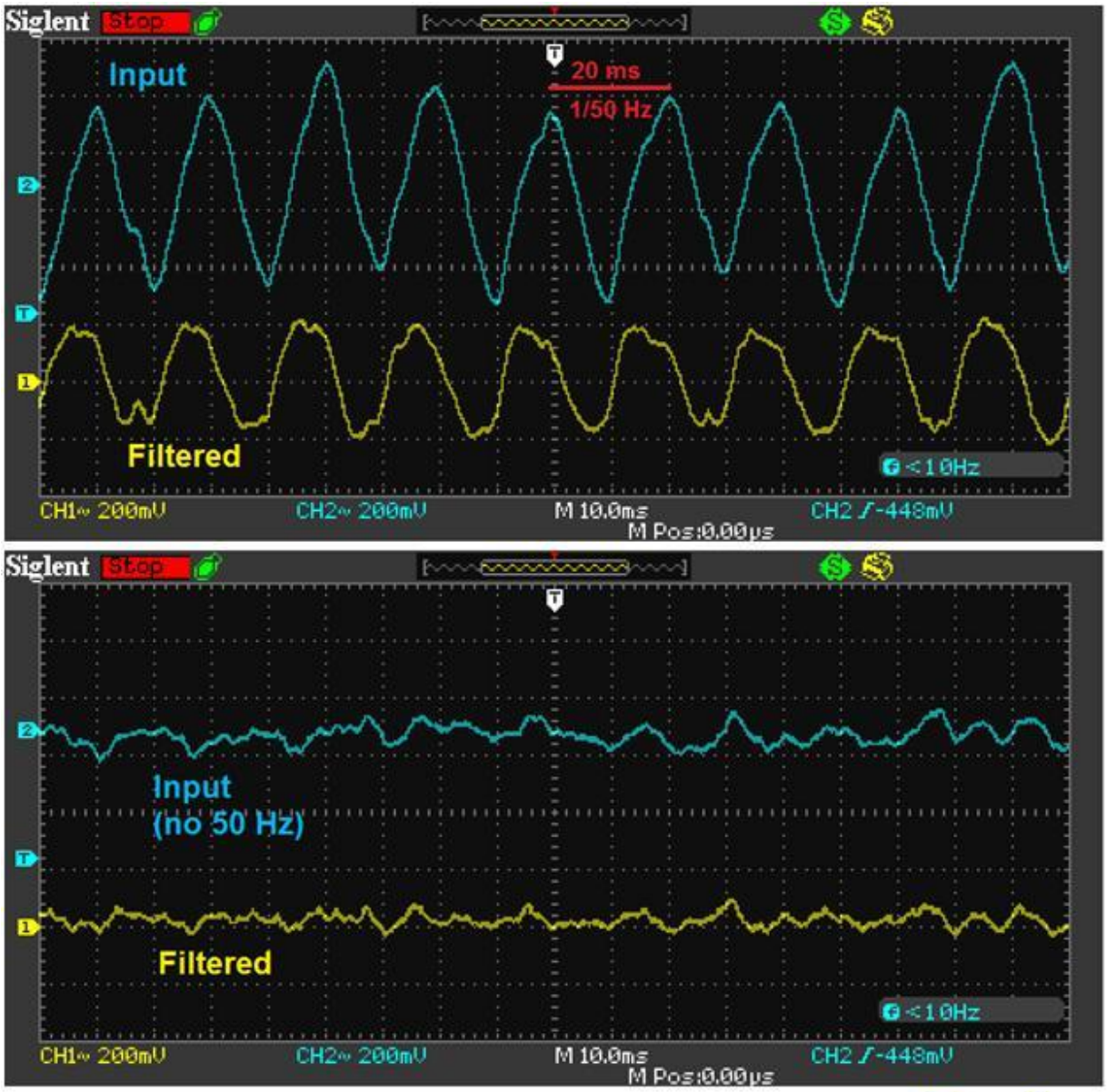


Fig. 3

Once I thought to do the experiment, I rushed to my bench and the experiment was done within a minute. No special credit for speed here (!) – the equipment was still set up from a previous experiment [4]. Fig. 3 here is Fig. 5 from, [4]. In the original experiment, I established that I could generate and play (with a stereo speaker) a sine wave of 50 Hz that had an amplitude that I judged to be the same as the Hum. What I found (top panel of Fig. 3, blue trace) was that such an acoustic signal was easily displayed (it was large). This meant that if the hum were acoustic, my setup should have easily displayed it. The Hum was missing (bottom panel of Fig. 3).

In the present experiment, I simply turned the 50 Hz signal back on and grunted to see if the sound went away for the one second interruption. There was no interruption. The real acoustic signal didn't respond at all to the bag of tricks.

Here is the protocol:

(1) First, make sure you are a "hearer" of the Hum on a regular or constant basis.

(2) Make sure you agree that you can "interrupt" the Hum by grunting, head-shaking, or maneuver of your choice.

(3) Set up a playback system such as connecting a function generator to a speaker as described in [4]. Adjust the amplitude and frequency for a best imitation of the Hum. If the real Hum is in the way of doing this, make the fake hum a bit louder.

(4) With the fake hum running, head-shake and grunt, etc. and see if the fake goes away. (Mine was rock stable.) [I could not simultaneously hear the real hum well enough to be SURE that it took its usual dives.]

WHAT DOES IT MEAN?

Well, to my mind, the fact that you can, PERSONALLY, interrupt the Hum means that it is generated inside yourself, not from an external source. This is a contention (conclusion at least) from some 20 years ago. The current additional experiment addresses the possibility that the interruptions might also apply to "sounds" that really are acoustic (synthetically generated) and in the corresponding ranges of amplitude and frequency. That is, do the interrupting mechanisms apply to signals known to be truly acoustic, not just to the perception of the Hum. Below we discuss this further.

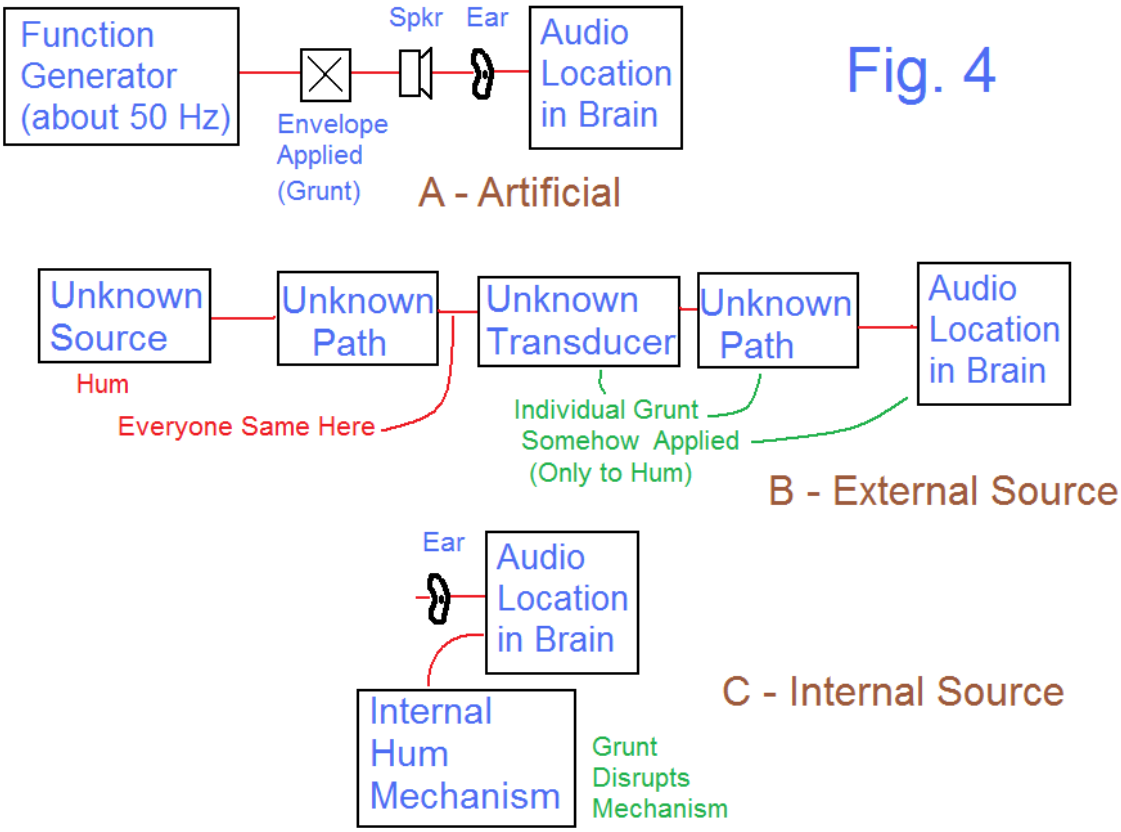


Fig. 4

In a moment we discuss the implications of the results of the experiment to the question of whether the Hum is internal, or externally sourced. Immediately however we can note that the result is additional evidence that the Hum, and a true acoustic signal are, in at least some aspects, <u>different</u>. The Hum is subject to interruptions that the acoustic signal isn't. That is, <u>the experiment is additional support for the idea that the Hum is not acoustic.</u> This itself makes the experiment worthwhile.

As to internal or external sourcing, Fig. 4 shows three scenarios that involve an interruption-like event. At the very top (A) we show a totally artificial event, done in the manner of a sound synthesizer. We have a very real function generator and we impose on it an envelope such as Fig. 1, top. The speaker makes this a very real acoustic event (a sound) and it goes to the ear where it is heard through normal hearing. Here, everything is known.

In Fig. 4 at the bottom (C) we show a case where an internal mechanism (not necessarily known in its particulars) is regularly pumping some Hum sensation to a location in the brain where normally a real audio signal would be received. Here we suppose that a disrupting event such as a grunt simply shuts down this mechanism.

The Hum generator recovers quite rapidly, and completely. Here we have in mind something like a muscular protective mechanism in the inner ear that has been "relieved of duty" and is searching or fluctuating for a signal. When something suddenly appears, the mechanism goes back to work (shutting down vibrations) but soon relaxing. Such a mechanism, producing a Hum, would also be shut down more generally by normal environmental (daytime) noise or intentional masking (running a fan) which don't give the mechanism any opportunities to relax.

Some critics of a suggested internal source say quite rightly that we could well have a personal internal mechanism that interrupts an external source. This accommodates some theories such as the notion that the Hum is caused by VLF (very low-frequency) radio, somehow interpreted by the hearer as real sound. Unfortunately, this postulates a fairly elaborate mechanism, or series of mechanisms, that would seem to have to have been set (in advance) in a special ("tuned") relationship. The middle portion of Fig. 4 (B) suggests the construction.

Looking at the left side of Fig. 4 (B) we see two unknowns, an unknown source (perhaps something very broadly like ocean waves or VLF radio) and an unknown path (acoustic, RF, earth vibrations) that deliver this, very roughly uniformly, to everyone on the planet. The point is that these are unknowns. We in turn do expect them to end up in a location in the brain that is accustomed (apparently) to receiving audio signals. It is unknown why relatively few (2% reported) persons "hear" this, and this scarcity of hearers (if true?) might well be a clue.

Between the source/path and the brain we need some sort of transducer and a path from the transducer to the brain. If this were an audio signal, these would be filled by the ear/inner-ear and the auditory nerve. But because we have good reasons to believe that there is no audio vibration at the ear, some unknown substitute is necessary. Add to this now the phenomenon that the Hum can be interrupted by actions of the hearer (which we describe as a grunt). Here we also note that ordinary audio, even mimicking the Hum, is not interrupted. That's four unknowns and a strange phenomenon (interruption). This is orders of magnitude more complex than the internal source of Fig. 4 (C). We can make wild guesses about the unknowns, but with little evidence. It is unlikely that these could be tested, or given likely (lack of) resources, that they would ever be tested. (Some of these guesses are quite absurd.) For all of them to work together, is too much of a "Just So" story.