

Hello All,

As always, please send any questions about the reading assignment directly to me at oldtimetelephones@goeaston.net. I will bundle questions if necessary, repeat the questions, and give answers in an e-mail to the TCI List Server before moving on to the next reading assignment. This way everyone will benefit from these questions and answers. By sending questions directly to me, we will avoid unnecessary clutter on the List Server. Previous reading assignments, notes, questions, and answers are available in the TCI Library at <http://www.telephonecollectors.info/telephony-101/>.

Please read the first part of Chapter 16 on pages 111-116. This actually covers the concept of central-office battery as well as the booster circuit.

Look back at Fig. 4-1 on page 30. In that basic circuit we had battery for transmitters and ac current went through everything. To keep battery out of the receiver (and to match impedances), a coil (transformer) was put in the circuit to isolate the transmitter from the receiver. This gave us the circuit in Fig. 4-2, which is the same as the circuit in the last chapter (Fig. 15-1). What if we just turned things around and put the receiver in a local circuit and put the transmitter in the line circuit?

This will work as shown in Fig. 16-2, which is another way to use the simple circuit in Fig. 4-1. But Fig. 4-1 shows the battery in series in the line, and this isn't going to work well if you want to hook additional phones to the same line. What you would like to have is a battery that is bridged across the line, sort of like the ringers. This way you could use a single battery for everyone. However, a battery has a near-zero internal resistance and it would short out all the ac signals (voice and ring). So Mr. Hayes devised a system using repeating coils (1:1 transformers) that would present a very high impedance to ac signals yet have a relatively low resistance to dc current. Some version of the Hayes system is used today. This system is described in the first section of Chapter 16.

Given this system, let's inquire about the circuit that you might use. Figure 16-2 shows the simplest circuit (without battery in the receiver) that would work on a Hayes-type common-battery (CB) system, but its performance is poor as discussed in the book. Bell engineers soon developed the so-called booster circuit, which puts a larger signal on the line than all the other circuits of its vintage.

I went crazy trying to find the patent for the booster circuit. Since I knew it was being used in the 1890s, I searched in vain for a patent in the 1890s – and was not able to find it for the 1st edition of the book. Eventually, I realized that the patent application had been substantially delayed, finally being issued in 1901. So the Bell system got exclusive use of this circuit from the early 1890s until its patent's expiration in 1918 – much longer than the usual 17 years. Pretty good!

Finally in this section you're going to learn about the large sidetone produced by the booster circuit. I remember to this day my first experience with the booster circuit. I had two WE 102s hooked up to my bench-top version of the Hayes system (a Radio Shack audio transformer and a lantern battery). I put one E1 handset to each ear and directed my speech into just one handset. I couldn't believe that the sound in the transmitting phone's receiver was so much louder than the sound in the receiving phone's receiver. Then I spoke into the other handset and heard the same result. Thus, before I had done any quantitative measurements, I concluded that this was a circuit only its mother could love. And low and behold the sidetone is so objectionable that the Bell System provided a circuit variation that reduced the sidetone (also reduced the line voltage). We'll see this circuit variation in the next reading assignment.

I don't know if you are as fascinated by induction coils as I am, but there is a lot of information about coils in Table 16-1 (and earlier in Table 15-1) and in the paragraphs below the tables. It took quite a while to untangle the different parameters and definitions, and I'm rather proud of the accuracy of the multiple measurements that were made (see p. 100). You won't find such comprehensive data anywhere else.

There's a lot in this reading assignment, so take your time and feel free to ask questions. If there are any questions about the current reading assignment, we will deal with the questions before moving on to the next reading assignment.

Ralph

Hello Again,

A reader asked two questions that I will try to answer here.

1. What is the electrical difference between a 3-conductor and a 4-conductor handset? My WE302 with a 5H dial has a 3 conductor hand set cord.

This is a very good question, and it will be addressed in future reading assignments. In the next reading assignment you will see that keeping the number of conductors to a minimum (i.e., 3) was desired to keep the cord small and flexible. Later on, when a varistor was used on the receiver element, a seemingly redundant 4th conductor was added to the handset cord. This change was related to the properties of the varistor and is explained starting on the bottom of page 166. Because we haven't talked about varistors yet, you might want to wait until we get into Chapter 19 to visit this question again.

2. Figure 16-4 shows a ringer. Where does the ac current come from for the ringer, and what is the purpose of the condenser in the ringer part of the circuit?

The low-frequency ac ringer current (about 20 cycles per second) comes from the central office. I have not shown this in any of the diagrams, and I really don't know how or where this is switched into the line. From the telephone's point of view, however, this 20 cps ac voltage (and corresponding ac current) just appears on the line when it is needed. The purpose of the condenser in the ringer part of the circuit is to keep dc current (battery for the transmitter) out of the ringer. Although this condenser has a pretty high impedance at 20 cps, the combined impedance of the ringer-condenser pair is relatively low because of phase differences as explained on page 43 of Chapter 6.

By the way, when testing a ringer with, say, a magneto, you have probably noticed that the ringer will ring just as well with and without its condenser. That is, the ringer has about the same impedance with or without its condenser (see page 43). Very convenient for testing!

Ralph