Telephony 101 –Principles of Standard Local Battery Circuit January 28, 2013

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 15 on the principles of the standard local-battery circuit on pages 99-102. We will concentrate for now on the basic circuit as described in the first four pages, and if you understand this, the rest will follow. Because the chapters on electrical circuits are a little harder to read than the chapters on telephone designs, I am going to slow down to 4 days per reading assignment. Please don't hesitate to ask questions about the electrical circuits because I want to make sure I have explained things adequately.

Look again at Fig. 4-2 on page 31 and get accustomed to focusing on the main circuit paths (again, think circles) of the voice circuit. View ringers and magnetos as other stuff just hung across the line. So Fig. 15-1 is just like Fig. 4-2 except there is a ringer and a magneto hung across the line.

For the purpose of understanding the circuit, we can talk separately about its dc operation, its ac operation at a ringer frequency of 20 cycles per second (cps), and its ac operation at a typical voice frequency of 1,000 cps.

The dc operation is simple and we only have to look at the part with the battery in it (there is no dc in the line part). For dc, the impedance of the coil is zero (see p. 219) plus any dc resistance of the coil wire. From Table 15-1, we see that the dc resistance of the primary winding of the common WE No. 13 coil is only 1.4 ohms, and we can ignore this in comparison with the transmitter's resistance of, let's say, 50 ohms (see Table 2-1 on p. 24). So if we are using two dry cells with a total voltage of 3 volts, then the current is 0.06 A (amps) or 60 mA (milliamps) based on Ohm's law. Thus, there is enough current going through the transmitter for it to work well.

I'm going to postpone discussion of operation at the ringer frequency until we get to the sure-ring condenser next time. This operation frequency will affect how the ringer works, but not how the voice circuit works.

For ac operation at voice frequencies (i.e., around 1,000 cps), look first at the local-battery part of the circuit. The battery has a very low internal resistance, so we're going to ignore it altogether (i.e., treat it like it's just shorted out). Also, we're going to ignore the resistance of the coil wire as before and just look at the two windings as a transformer. Finally when transmitting, with the transmitter resistance going up and down at around 1,000 cps, the current is varying at the same frequency and producing an ac voltage across the transmitter's resistance. The transmitter thus looks like an ac voltage source in this circuit when transmitting (Fig. 15-2) and merely as a resistor when receiving (Fig. 15-3).

Next look at the line part of the circuit in Fig. 15-1 for ac operation at voice frequencies. The magneto is disconnected from the circuit when talking, so we can ignore it and leave it out of our diagram for ac. The ringer is connected, but the ringer's impedance at 1,000 cps is more than 20,000 ohms (Table 6-1). This is so much greater than the receiver's impedance (about 250 ohms, Table 3-1) and the transformer-coupled transmitter (about 800 ohms, see p. 224), that an insignificant amount of voice-frequency ac current will go through the ringer and it can be ignored, too.

Therefore, the complete circuit in Fig. 15-1 can be replaced by the simpler circuit in Figs. 15-2 and 15-3 for ac voice frequency analysis. Now just read the rest of the assignment in the book and you should be able to understand how the standard local-battery circuit works. You will see later that the line voltage (210 mV in my measurements) is greater for this old local-battery circuit than for most of the later common-battery circuits. Simple, in this case, is really better.

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