Telephony 101 – Condensers December 19, 2012

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 section called Condenser in the Appendix on pages 218 and 219. Also review the sections on Resistor and Coil on pages 218, 219, and 220.

Imagine two parallel metal plates that are very close together but not touching. Now connect the plates to a battery with wires forming a circuit (circle). If these plates were not close to each other, nothing would happen because the circuit would be open. But since these plates are very close together, something interesting happens. A little current (i.e., the movement of electrical charges) will flow, and positive charges (+) will build up on one plate while negative charges (-) build up on the other plate. Because these plates are close together, the positive and negative charges feel each others' attraction, and this is what holds the charges on the plates. If the plates were farther apart, the charges would not feel each other and the battery would not be able to move the electrical charges (i.e., zero current).

As these charges build up on the plates, they create their own back voltage. When this voltage equals that of the battery, the current stops flowing. This all happens very fast, but you can see that the current is maximum at the beginning of the charging period and goes to zero at the end. In contrast, the back voltage is zero at the beginning and maximum (battery voltage) at the end of the charging period.

Now if you use an ac voltage source instead of a battery to charge the plates, the charges will go back and forth, charging the plates one way and then reversing the charge when the voltage reverses. This back-and-forth movement of electrical charges is, in fact, an ac current even though no particular electrical charge ever makes it all the way around the circuit. Pretty cool!

Because the current and voltage reach their peaks at different times, there is a phase issue with condensers as there was for coils. Refer back to our notes on Receiver Specifications and the discussion of phase angles for coils. We started an imaginary current cycle at zero current at the beginning of the cycle. If we do this for our parallel plates (i.e., a condenser), as the current goes from zero to a maximum, and then back down to zero, etc., the voltage goes from maximum to zero to minimum, etc. Thus the voltage and the current in a condenser are also 90 degrees out of phase, as they were in a coil.

It's more difficult to show that the sign of the phase angles are different for a condenser and a coil, and I won't try to demonstrate this. But in one case the phase angle is plus (+) 90 degrees and in the other case it is minus (-) 90 degrees. For me it's easier to consider the current as the "constant" since at every instant, the current everywhere in a circuit (in a coil, in a condenser, in a resistor, etc.) will be the same. So I like to think about the voltage lagging or leading the current rather than the current leading or lagging the voltage. Thus the voltage leads the current (by 90 degrees) in a coil whereas the voltage lags the current (by 90 degrees) in a condenser. And of course the voltage is exactly in phase with the current in a resistor.

As pointed out on p. 218 in the Appendix, the impedance of a resistor (i.e., its resistance) does not depend on frequency and is the same for ac and dc. Then how can a component such as a condenser (or a coil) have a frequency-dependent resistance as mentioned on p. 219? The answer has to do with bulk materials. When bulk conducting materials (e.g., large-area plates of a condenser or a big iron core in a coil) are present, the alternating magnetic field produced by nearby ac current induces currents in these bulk materials – and these currents just swirl around (eddy currents) within the bulk materials. Since these materials have inherent resistance, it shows up in the overall impedance of the condenser (or the coil) as a frequency-dependent resistance because the magnetic induction process is frequency-dependent.

In summary, you should try to remember the following:

1. The impedance of a resistor is constant, and a resistor passes (i.e., lets through) ac and dc.

2. The impedance of a condenser gets smaller with increasing ac frequency, and a condenser will not pass dc at all.

3. The impedance of a coil gets bigger with increasing ac frequency, and a coil will pass dc but will tend to block high-frequency ac.

4. Current and voltage in ac circuits are not in phase (i.e., they don't go up and down together) in condensers and coils.

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

Telephony 101 – Condensers December 23, 2012

Hello All,

A reader asked the following question:

I know now that old phones get the dc from their batteries, but where do newer phones get their dc? Are ac and dc coming from the line?

The answer is "yes." Newer common-battery phones get their dc on the line from the central office, and the ac voice signal rides on top of the dc. We will get to this subject in detail in Chapter 10. Stay tuned.

If you have any follow-up questions about condensers, send them directly to me. We will now move on to the next reading assignment, which I posted this morning.

Ralph