Telephony 101 – Western Electric's Anti-sidetone Circuit February 17, 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 17 on pages 125 through most of page 132. At this point in the telephone's history, all of the manufacturers had converged on the booster circuit and all of them thus had a strong motive to do something about its nasty sidetone. Each manufacturer started with their own anti-sidetone (AST) circuit, yet all again eventually converged on the Western Electric circuit – except for Kellogg, which had a rather nice bridge-type circuit of its own.

I also want to preface this chapter by pointing out that anti-sidetone does not mean zero sidetone. We need sidetone or otherwise we will think the phone is dead. But you would like to have the efficiency of the booster circuit without its annoyingly high sidetone. So the goal of the anti-sidetone circuits was to get a high-efficiency circuit with a sidetone that was about neutral (i.e., volume in the receiver about the same when talking and listening).

Western Electric had a very smart mathematician who worked out possible variations of efficient AST circuits, from which Western Electric picked one – and the reasons for the particular choice are interesting (see page 126). So it is not surprising that Stromberg-Carlson and Automatic Electric eventually settled on Western's mathematically sound circuit. Kellogg's Triad circuit was a bridge-type circuit, which also has a very sound mathematical basis, and Kellogg stuck with the Triad until the 500-type phones came along.

Western Electric's circuit, seen in Fig. 17-1, is a variation of the old booster circuit, with an extra high-resistance coil section wound on top of the No. 46 booster coil. This extra coil provides a bypass around the receiver for some of the ac voice current.

Twenty years ago when I wrote this part about how the AST circuit worked, I tried to follow the explanation provided in Gibbon's 1938 article in The Bell System Technical Journal. I don't know if I ever had a full understanding of Gibbon's explanation, but now after twenty years it doesn't seem very clear. So let's just try to get an approximate explanation that we can all understand.

When transmitting, the transmitter is the source of energy for the ac voice signal. It produces a relatively high voltage (75 mV in my measurements), and it drives ac current through the receiver circuit as well as through the line circuit – just as the old booster circuit did. In this

AST circuit, however, some of the current through the receiver circuit bypasses the receiver and this lowers the sidetone. There you have it!

When receiving, the transmitter is just a passive resistor in the line circuit with a relatively lower voltage across it (30 mV in my measurements). This voltage will add to voltages induced in the secondary and tertiary windings of the coil and cause ac current to flow through the receiver circuit. Some of this current will of course flow through the receiver and make it work. Clearly, the parameters in the receiver circuit are different when receiving from when transmitting. Thus one hopes that the current through (and therefore the voltage across) the receiver will be at least as large when receiving as when transmitting.

In my measurements, they are the same (30 mV in both cases), and this is a vast improvement over the booster circuit in which the receiver voltage when transmitting was almost 3 times the voltage when receiving.

If you've really been paying attention, you might ask if the booster still doesn't out-perform the AST in terms of receiver volume when receiving (45 mV with the booster and only 30 mV with the AST). The answer is, not necessarily. Sound volume is going to be related to power in the receiver rather than just the voltage. And the AST was tested with HA1 receivers (120 ohms at 1,000 cps) whereas the booster was tested with No. 144 receivers (240 ohms). Since power is going to be voltage squared divided by impedance, the receiver power is 8.4 microwatts for the booster and 7.5 for the AST, which are about the same considering the uncertainty in my measured values (I trust them, but they do have uncertainty in them).

So the bottom line on the WE AST circuit is that it eliminates the objectionably large sidetone of the booster circuit, puts a good voltage on the line, and delivers about the same receiver volume at the receiving end. Pretty good.

You'll see in this reading assignment how a candlestick and a handset phone are wired with this AST circuit, and you'll also see the wiring of the ubiquitous WE 302. Party lines were prevalent during the time of the WE 302s, so you will also see how they were wired up in this reading assignment. Hence you will learn about the No. 101B induction coil with the center-tap labeled "M." Therefore, if you have a 300-type phone with the 101B coil, you can figure out how to make the connection for single-line phone service.

There's a lot packed into this reading assignment, and I hope you find it as interesting as I did.

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 – Western Electric's Anti-sidetone Circuit February 20, 2013

Hello Again,

Several questions and comments on this subject were directed to me, and I will try to answer them below so this discussion will be in the Telephony 101 archive. In addition, lengthy discussions erupted on the TCI list server about Campbell's analysis, why the Bell System seemed to delay introduction of the AST circuit, and other related topics. I will not repeat those discussions.

One reader asked what was the first dial phone from Western Electric with an AST circuit – and what year did this become available to the public. The best answer I can give is on page 72, where I point out that the smaller bakelite subset was introduced in 1930. It was very close to this date that the AST circuit was introduced in both the regular metal subset (then called No. 634) and the smaller bakelite subset (then called No. 684). These subsets could be used with the A-type, B-type, or D-type handset mountings, and any of these combinations would be called a No. 202 telephone. So I don't know which of these handset mountings would be "first," but the first Bell System phone with an AST circuit appeared around 1930 and would have been called a No. 202.

This reader also provided the following interesting comment:

"I remember to have read recently that Western Electric is supposed to be the first manufacturer shipping phones with anti-sidetone circuitry. If your dates are correct, then Western however was not the first, as Siemens & Halske shipped its model VSa tist 66c already in 1927 - I have in my collection this phone with serial no. 05553.

"And since 1928, the Reichspost, Germany's monopoly carrier at that time, shipped its new monopoly phone, the model W28, with anti-sidetone circuitry. This W28 had been derived from the above 1927 Siemens model and was manufactured by a number of companies for the Reichspost."

Another reader provided this observant comment:

"When I read your book a few years ago, and even still today, I marveled at how Western Electric, Kellogg, and all the rest were able to do so much with what amounts to passive circuitry. The only form of amplification was to leverage a DC supply through a carbon microphone, and the use of transformers. Truly amazing."

Another reader asked why manufacturers continued to offer, and users accepted, sets with sidetone circuits once anti-sidetone circuits were developed? Were the sidetone sets so much cheaper to make?

I can only speculate that it had to do with inventory of equipment that was designed to last for 40 years. I believe that manufacturers would have just used up their inventory of sidetone subsets or converted new ones without going into the field to upgrade to AST because of cost. When combined telephones were introduced, they all had AST circuits.

Ralph