

# Building a 1929 Style Hartley Transmitter

By Scott M. Freeberg, WA9WFA  
Boston Scientific Corporation  
4100 Hamline Avenue North  
Saint Paul, MN 55112-5798

Tel 651.582.4057 *begin\_of\_the\_skype\_highlighting*  
651.582.4057 *FREE end\_of\_the\_skype\_highlighting*  
[scott.freeberg@bsci.com](mailto:scott.freeberg@bsci.com)



AT&T Engineer Ralph Hartley

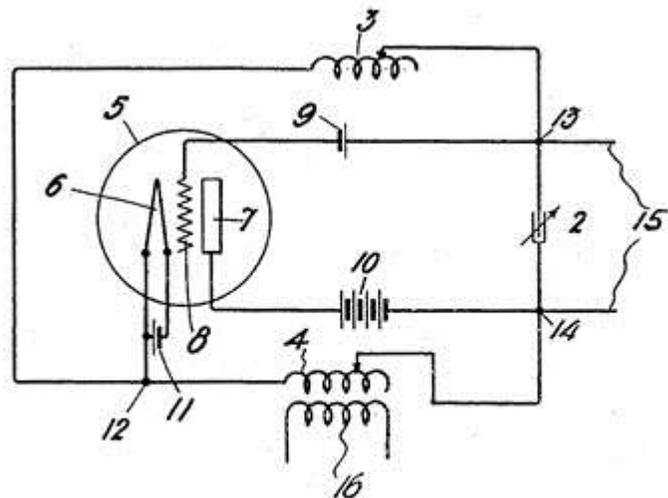
## General Background

In the 1920s hams were embracing the latest technologies as they migrated from rotary and mechanical spark transmitters to the new electron tube based oscillators and transmitters. To the modern eye, that '20s technology may seem crude and unusable but there are a group of AWA hams today that are still building those transmitters and using them on the air to contact other hams around the country.

In the December 2008 AWA Bruce Kelley Memorial 1929 QSO Party, there were approximately 58 stations on the air using 1929 style transmitters on 3.5 MHz and 7.0 MHz. If you've thought about building and operating your own 1929 transmitter, here is your chance. This article will discuss how to build an 80 meter 1929 style transmitter that can be used in the 1929 QSO Party or any other time for that matter.

This oscillator configuration was invented by Ralph Hartley, an engineer from AT&T, in 1915. The "Hartley Oscillator," as it was usually called, was a popular transmitter during the 1920s. It is a simple circuit consisting of two coils, a variable capacitor, the tube, and a handful of small parts. Don't be fooled though. This simple circuit is easily capable of working coast to coast and around the world.

The circuit that I used was published in QST August, 1928 and is typical of the configuration used in the 20s and 30s. I've taken some liberty with the component



The Original Hartley Patent: #1,356,763

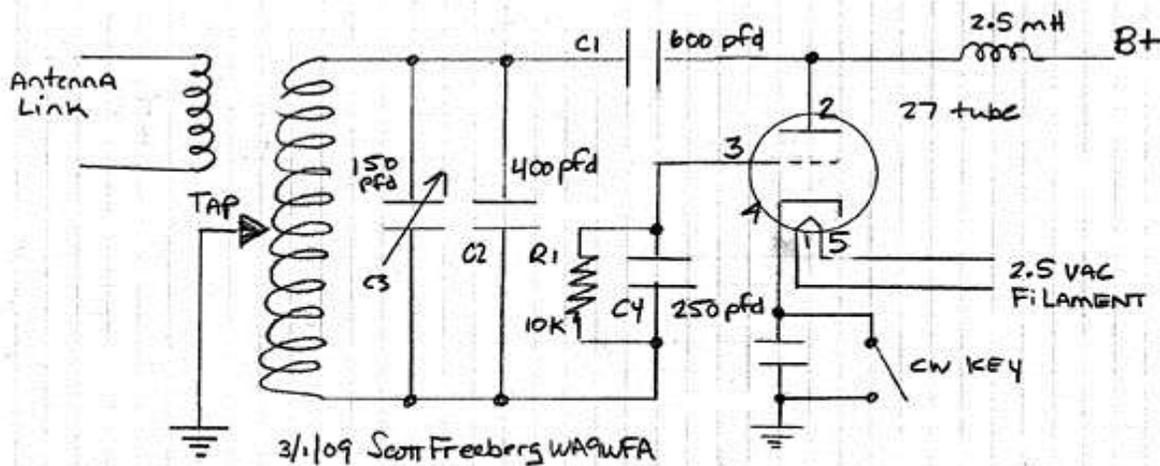
values to reflect what I had in my junkbox. The transmitter is capable of producing a pleasant and fairly stable CW tone. While working this year's AWA 1929 QSO Party, I heard several absolutely beautiful Hartley oscillators, so there's no reason for you to have anything less than a gorgeous signal.

I've never built a single-tube Hartley transmitter before so I thought that putting one together while writing this article would be a good experience for both you and me. And it was. I started building it Saturday morning and finished the testing by early Sunday afternoon.

1920s era tubes can range in price from a few dollars to hundreds of dollars. For this project I selected the type 27, which is very inexpensive. The 27 (this type number might be preceded by UX2 or UX3 in older versions) was a very popular audio tube in the 1920s and can be purchased at hamfests in the range of \$3-\$5. It is a 5-pin glass envelope triode with an indirectly heated cathode. Lighting the heater requires 2.5 volts AC @ 1.75 amperes. The type 27 is capable of generating 2 to 4 watts of output power depending on the plate voltage and plate current.

### Construction

I've included the schematic diagram of my transmitter with the actual values of the parts that I used. For the PA tuning capacitor, I used a parallel combination of 400 pF fixed and 150 pF variable. The fixed capacitor places the transmitter in the band; the variable capacitor gives us some bandspread tuning around the band. This circuit also has a 600 pF capacitor in series between the high voltage and the PA coil. This keeps the high voltage off of the coil and reduces the risk of shock. The transmitter was built on a piece of wood and almost all the components were attached with woodscrews. Just two machine screws were used. This genuine 1920's construction technique is a real treat to work with because it's not only easy to place parts, but you can also change your mind and move them in a matter of seconds. With a cordless drill and a box of wood screws, you can complete the job in short order.



Schematic of my Hartley, showing values of the parts I used.

The parts were assembled on an 8" x 10" piece of 3/4" thick pine board. The dimensions are not critical but if this is your first transmitter project, it might be

prudent to leave yourself some extra space to work with. Parts placement is not critical in general but keeping the parts close together and connections as short as possible are important for the stability of this transmitter.

I set the major parts on the board and moved them around until I came up with a placement that looked like it would have short connections and a good circuit flow. The PA coil and standoffs were mounted first. The coil consists of 13 turns of 1/4" copper tubing 3" in diameter. I wound the copper tubing on a 2.5" piece of PVC tubing and then slid the tubing off the form. The coil is suspended between two ceramic standoffs.

I love the look of a copper tubing coil because it is so typical of the real 1929 transmitters. I did have to experiment with the number of turns on the coil versus the tuning capacitance in order to get the transmitter into the 80 meter band. A grid dip meter was used to help determine the right amount of inductance (turns of copper tubing) and the fixed/variable capacitor to put the transmitter on 3550 kHz. It turns out the grid dip oscillator readings were right on the mark because the transmitter did indeed tune to 3550 kHz with no problems.

The variable tuning capacitor and tube socket were placed in front of the PA coil. As mentioned virtually all the parts were fastened with wood screws. The two machine screws were used to mount the variable capacitor.

The LC tank circuit connections should be made with a beefy wire or tubing connection in order to offer the lowest possible resistance to the high circulating currents that occur here. All PA tank circuit connections were made with 1/4" copper tubing that was squeezed flat with holes drilled at the ends for making connections. I chose the flattened copper tubing just because I wanted to try it, I liked its looks, and I knew it would have excellent current carrying capabilities.

The other connections can be made using #12 or #14 copper house wiring with the vinyl insulation removed. I like the current carrying ability of the wire and the fact that it can be bent to create right angle wire routing similar to the look of the real 1920s transmitters. Key and power supply connections are brought onto the board using brass Fahnestock clips that I purchased at the AWA Convention.

For safety reasons, I placed the high voltage Fahnestock clips at the rear of the board. The 2.5 volt filament clips were placed near the tube, on the left side, center. The clips for the key are on the left side of the chassis, closest to the operator.

### **Tuning**

The only two "tune up" adjustments on the Hartley oscillator are the placement of the PA coil ground tap and the position of the antenna link on the PA coil. You will have to experiment with the ground tap location to discover the spot that provides just the right amount of grid drive and yields the best sounding tone. When I first powered up the transmitter it had a nasty buzzy tone, but I was able to move the clip lead to a tap position that yielded both safe plate current and good tone.

My transmitter worked great with the tap position shown in the picture, which is the sixth turn from the grid side (left side). The second adjust is the physical placement of the antenna link coil near the PA coil. For the antenna link, I simply coiled up two turns of #14 AWG house wire, leaving the insulation on, and inserted it in between the first and second turn of the PA coil at the grid end. I ran this connection right to the coax antenna cable.



Here's the completed Hartley; it was an easy weekend project.

Between the tap setting and the antenna link coupling, I was able to get two to four watts

output depending on how hard I drove the tube. The goal is to adjust the antenna link coil to give you a decent power output and yet maintain a decent tone.

Generally the harder the tube is driven, the worse the tone becomes, so it is a balancing act between power output, frequency stability, and tone.

For the filament voltage I used a 2.5 vac transformer. For the high voltage power supply, I used a Heathkit TBD HV regulated power supply. With the tap and antenna link position that I discussed, this transmitter was drawing approximately 35 millamperes at 200 volts. I measured 2 watts output into a Bird wattmeter and 50 ohm dummy load. The input power was 7 watts, output power 2 watts, yielding an efficiency of 28%. That's pretty darn good for an audio tube. Out of curiosity, I cranked up the high voltage to 250 volts and set the PA coil tap to yield 50 mA plate current. This resulted in 4 watts output with a good sounding tone.

### **Conclusion**

In the 1920's the Hartley was the state of the art in tube oscillators and a favorite transmitter configuration of the 1920s hams. Some 90 years later in 2008 this transmitter circuit is still extremely popular and being used in 1929 style transmitters for making ham radio contacts coast to coast. So even as the world rapidly changes around us, there are some things that remain the same and generate as much joy today as they it did the distant past.

I enjoyed sharing this article with you and building my own Hartley transmitter at the same time. I hope you build your transmitter too because we'd love to hear you in the next AWA Bruce Kelly Memorial 1929 QSO Party.