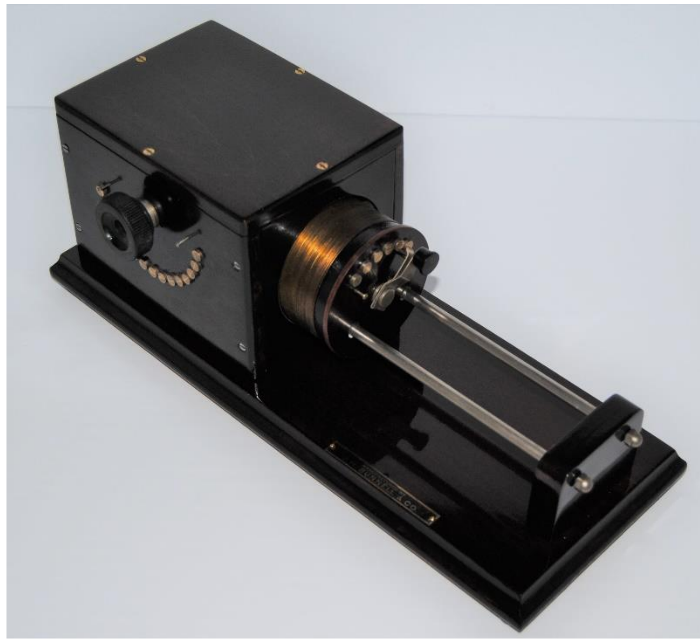
Crystal radio with a J.H. Bunnell & Co loose coupler



I was always curious about the performances of early radios with original components. Having this in mind, I have acquired this J.H. Bunnell & Co loose coupler from eBay in 2021 (after the auction, around 500 CAD including shipping and duty fees). On his back, a green sticker indicates: *property of Harold S. Greenwood, W6MEA, 1919*. This is 100 years gap up to me, another amateur radio (YO5OBW in Romania and VA2OBW in Canada).

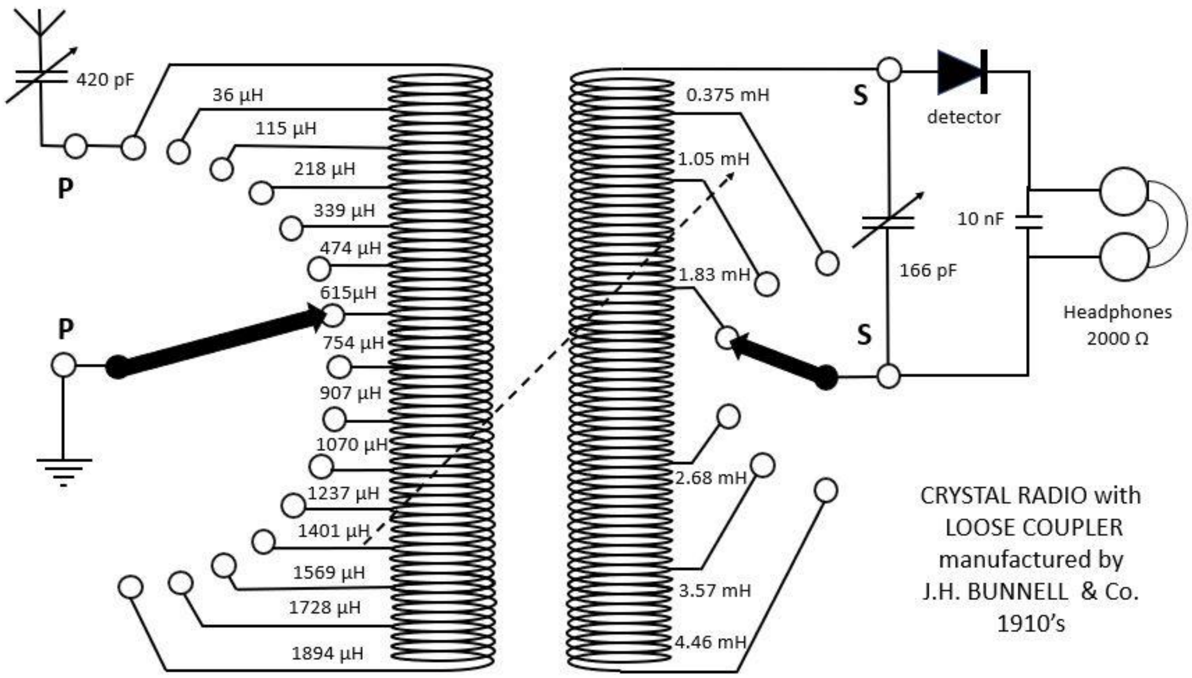
First step it was a deep cleaning of brass contacts, soldering coil wires to contacts, and wood case restoration. As for ancient radios, I have used some sandpaper from 60 up to 600 dpi, wood finish penetrating stain (red mahogany) and oil based glossy varnish. I have not sanded up to the wood, except some really damaged surfaces, in order to keep as much as possible of ancient color and patina. The wood is red mahogany, as for many of the 1920's radios.

The photo after restoration shows the beauty of this early radio device.

After assembling, I have carefully measured the inductance values with the Agilent U1732C handheld LCR meter. The values of both coils are indicated in the schematic below. Primary (P) switch is on the side, Secondary (S) on the moving coil.

The loose coupler can be used in various simple crystal radio or regenerative receivers for tuning and antenna coupling. It is an air core transformer, therefore can be used in both directions (antenna and ground can be connected as usual at primary, but also at secondary). Of course, the other side is connected to detector and headphones.

After several web searches and tests on my test bench, the schematic of the best crystal receiver using this loose coupler is shown in the next figure.



TEST BENCH

A. In the first step I have used as detector a germanium diode for easy tuning and learning purposes. All tests are after performed with a vertical crystal detector from my collection.
B. The receiver covers LW, MW and a small portion of SW (no more than 3 MHz), as tested with my Rohde & Schwarz SM300 signal generator.
C. For initial reception test, with high impedance headphones, I have used for convenience an active magnetic loop antenna, instead of an external long wire antenna of 100 ft, as a century ago. Of course, the active antenna has a built-in RF amplifier that helps a lot. Sound is strong and crystal clear in the high impedance headphones, with a perfect AM tuning of local AM stations from 600 kHz to 1410 kHz.
D. When my vintage "*de Forest Crosley*" 2 tube amplifier (2 x 201A tubes) is used to amplify the AF signal, the antenna is a single 10 ft indoor wire and the ground is connected to my

Ham radio equipment ground. The signal in the headphones is barely audible in this case, but a strong signal is obtained in the vintage high impedance speaker, with little distortions. When this vintage amplifier is replaced by a modern guitar amplifier the sound quality is exceptional, as in the headphones.

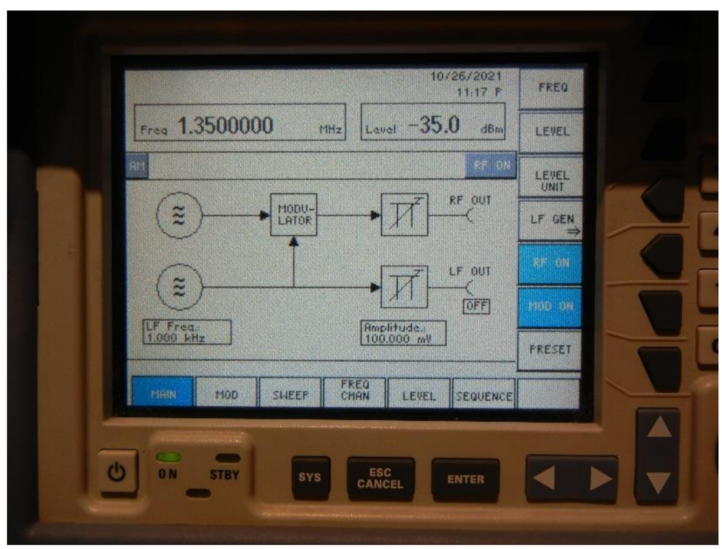
E. In the case of the use of a fixed capacitor in series with the antenna, we can take advantage of the variable inductance of the primary. Of course, is not a continuous tuning because of limited number of coil outputs. That is why some vintage loose couplers use a continuous sliding contact. If for example C = 150 pF in series with the antenna and static coil, for each value of primary inductance, the tuning frequencies are listed below.

No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**
L (μH)	36	115	218	339	474	615	754
f (kHz)	2165	1211	880	705	597	524	473
No.	**8**	**9**	**10**	**11**	**12**	**13**	**14**
L (μH)	907	1070	1237	1401	1569	1728	1894
f (kHz)	431	397	370	347	328	312	298

F. The best continuous AM band coverage is obtained using a variable series capacitor with the antenna, and positions number 6/14 of the static coil (P) of the loose coupler, as indicated in the next table.

L (μH)	615	615	615	615	615	615	615	615	615	615	615
C (pF)	14.4	21	24	28.6	34	41	51	64	84	114	150
f (kHz)	1690	1400	1300	1200	1100	1000	900	800	700	600	525

G. Measurements with Rohde & Schwarz signal generator with the corresponding adapter for the impedance of a long wire antenna, shows a sensitivity of around – 35 dBm over the AM band, with a decent signal to noise ratio in the headphones. The AF gain of the DeForest 2 tube amplifier is around 30 dB and the crystal diode needs some dozens of mV to operate. In comparison, the sensitivity of a 1924 Atwater Kent model 20 receiver, having 6 X 201A tubes, is around -60 dBm.



In conclusion, the sensitivity of the loose coupler crystal receiver is good enough to receive local stations on a high impedance speaker, with a vintage 2 tubes AF amplifier and a 10 ft. indoor antenna. The sound quality is very good, but adjusting the crystal detector and loose coupler tuning require experience.

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