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Journal of the

CALIFORNIA HISTORICAL RADIO SOCIETY

Master of Ceremonies Stan Bunger

Auctioneer Renee Richardson

Auctioneer Dan Ashley

Candy Mason P.I. Radio Play

Radio Day 2017 Best Ever!

Golden Gate Radio Orchestra

FOR THE RESTORATION AND PRESERVATION OF EARLY RADIO

FROM THE BIRTHPLACE OF BROADCASTING

California Historical Radio Society

HOME OF THE BAY AREA RADIO MUSEUM & HALL OF FAME

The California Historical Radio Society (CHRS), is a non-profit educational corporation chartered in the State of California. Formed in 1974, CHRS promotes the restoration and preservation of early radio and broadcasting. Our goal is to enable the exchange of information on the history of radio, particularly in the West, with emphasis on collecting, preserving, and displaying early equipment, literature, and programs. Yearly membership is $30 ($40 non-USA).

CHRS Museum in Alameda

CHRS has been fortunate to through the generosity of its donors to purchase a home for the CHRS museum and education center. It is located at 2152 Central Avenue. The building was built in 1900 as a telephone exchange.

CHRS volunteers are actively restoring the building to make it optimal for use. Our goal is to create an environment to share our knowledge and love of radio and enable us to create an appreciation and understanding for a new generation of antique radio collectors and historians.

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Contact us:

CHRS, PO Box 31659, San Francisco, CA 94131
or info@californiahistoricalradio.com

Visit us at: www.CaliforniaHistoricalRadio.com

Contents of the Journal

From the Editor

In this issue John Staples discusses radio propagation experiments during the recent eclipse. Bart Lee provides a simple experiment related to the eclipse effects. Then Greg Sanders provides an overview of antenna theory as it applies to the Zenith Wavemagnet. Jason Vanderhill describes a rare 1920s radio manufactured in Oakland. Len Shapiro shares 1930s Bay Area broadcast related photos from the Carl Christiansen archive. And I provide an overview of my recent mechanical television project. Once again I've had the pleasure of working with very generous and capable contributors.

I am always in need of quality content related to broadcast radio, ham radio, and television. If you have something to contribute, I urge you to let me know. I am especially interested in technical content. It can be of two types, a narrow topic in depth or a more broad topic with less depth. Enjoy . . .

Richard Watts, jrchrs@comcast.net

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From The President

by Steve Kushman

As we approach the end of 2017, we can say this has been a bittersweet year for our favorite vintage radio society. The sweet is that CHRS continues to grow and thrive. We have been signing up new members… some with all their hair, and not gray. We have been taking in many donations. Some have enriched our collection and some have bolstered our bank balance. We have discovered that 1950s and '60s radios which were routinely not collected by traditional radio enthusiasts, can be painted, restored, equipped with blue tooth and sold for good prices to younger people who want a mid 20th century antique in their homes… especially if they can play their own music through the set. Mid century consoles with blue tooth also sell well. People are playing records again and these stylish consoles fit the bill. We have recently held a successful Radio History class, hosted the BARHOF Station of the Year & Radio Hall Of Fame Induction events with The Broadcast Legends, and in July presented our Best Radio Day By The Bay ever! We netted $24,000 and had 425 guests!

Now the bitter… 2017 might be called the year that Mother Nature showed us humans who is really the boss. Tornados, earthquakes, hurricanes, wildfires and floods were all intense this year. Millions of people and structures were affected, including CHRS and Radio Central. After 3 dry winters at Radio Central, earlier this year we experienced the effects of a hundred year rain and flood. Our 117-year-old building's basement floor, about 5 feet below ground, began flooding from rising groundwater. For weeks we pumped and vacuumed hundreds of thousands of gallons of water out of the flooded area. Just the main section of the 1900 portion of the building flooded. The new 1926 addition was fine. No artifacts or equipment was damaged. The damage occurred were we had made no improvements, except for one library wall. The water kept rising from the many cracks in our 117-year-old concrete floor.

The solution to our problem would not be cheap or simple, but had to be done. It includes replacing the old cracked concrete floor with a new re-enforced concrete slab with a new rock drain field, incorporating finger drains below, a new sump pit with dual pumps and 5 forms of waterproofing under, within and around the slab. And while we are at it, we are installing an ADA approved wheelchair lift, new stairways, new office and display galleries. As of this writing, the project is well under way and going well. Some of the original concrete that was removed was as thin as 1¼" in some areas and as thick as 5" in other areas. We will have a new waterproof concrete floor in place before the rainy season starts here in the Bay Area.

The construction project for this year was supposed to be the Great Hall upstairs and we were seeking $50,000 in donations. When the Great Flood Of 2017 occurred, our priorities shifted to the basement flood control project. Many people realized the importance of this project and were extremely generous with their gifts. By the end of this year, CHRS will have raised almost $250,000 for our construction fund. Thanks to these passionate supporters, we are doing a first rate job on this, and on all projects at Radio Central. Thank you to everyone who contributed to this year's fund. And we can not forget to thank our dedicated volunteer staff who vacuumed and squeegeed water for weeks and moved many items, some very heavy, out of harms way in a hurry. Thank You!

The downstairs floor progress at the time of this journal printing. The old floor was removed, drain trenches were dug, and the area covered by a thick layer of gravel. Then the thick white Preprufe covering forms a waterproof barrier. Next the rebar grid will be raised on dobies, and then the pour of the 6" thick concrete floor. The brick walls were sandblasted.

Have a Happy Holiday season. And drop in to Radio Central any Saturday from 9 to 3. Also, I would really like to hear from you. Please call or email with any comments or complaints.

Best Regards, Steve (415) 203-2747
Steve@CHRSRadio.com ◊

Radio Central Renovation Update

Original circa 1900 exterior front elevation of 2152 Central Ave.

Downstairs Gallery: The 100 year-old floor downstairs was in a very degraded condition and, in places thin and structurally unsound. Its poor condition was the primary contributor in allowing ground water to flow into and flood the downstairs gallery last winter. Structural engineers and hydrology experts were consulted and provided the unanimous recommendation to remove and replace the worst parts of the floor. Volunteers lead by Cliff Farwell removed the stairs and portions the walls, and the contractor has removed the old floor. During this project, below-ground walls will be treated to prevent water seepage were necessary. The floor replacement is to be completed before the upcoming rainy season begins. After the floor is installed, then the walls and stairs will be reconstructed, an ADA wheel-chair lift will be installed, and the room will be finished and configured for museum displays and a meeting area.

Front Facade: While removing walls for the Downstairs Gallery floor replacement, it was necessary to remove a portion of the interior wall at the front of the building just behind the facade. This revealed the original round columns which flank the front door, as shown in the photo above. They are still in good condition. Very good news in looking forward to the day we can remove the facade and restore the building's front exterior to its original design.

Surplus Storage Shed: The surplus storage shed along the side of the building was completed in time to be used for Radio Day. Keith Scott was the project lead. This will be used to store surplus items, and to display items that are available for purchase at events.

Outdoor Shade Covering: A freestanding vinyl cover has been erected in the back outdoor area to provide much needed shade over the picnic tables.

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Denny, Hill, Dave, and John removing water from the flooded basement. An ongoing job as the water repeatedly flowed in when it rained — which, last winter, was often.

CHRS Central Valley Chapter News

by Scott Scheidt

October 7th, the CHRS Central Valley Chapter held its 17th annual vintage radio sale, swap meet, silent auction, and raffle. The weather was perfect. There were many sellers offering a large variety of radio treasures, test equipment, and parts. Several club radios or radios donated by CVC members where raffled or won in the silent auction. The sound of the golden age of radio was presented by Harold Peterson, a DJ from KCSS. The meet was very successful and well attended.

In June, CVC held its BBQ luncheon at the clubhouse. During the event, Bill Warner demonstrated connecting an MP3 player to a vintage radio.

CVC offers a weekly radio theory and repair class. CVC also continues to offer the Radio Repair Clinic every Wednesday, 6-8 PM.

Membership meetings are held on the 3rd Saturday every month at 10:30 AM at the CVC clubhouse at the corner of Bradbury and Commons just Southwest of Turlock. ◊

KCSS DJ Harold Peterson plays the music from the golden age of radio.

The Eclipse, WWVB, SIDs, Thunderstorms and Earwigs

By John Staples, W6BM

The eclipse of 27 August 2017 was more than a visual event. It caused a disturbance in the ionosphere, changing propagation conditions of radio signals. Several of us "tuned in" to record any effect that may have occurred.

The Ionosphere

The ionosphere is a layer of the atmosphere that extends from about 40 miles above the earth to over 500 miles. The air up there is thin, but plays a vital role in the propagation of radio signals. At that elevation, ultraviolet and X-rays from the sun, as well as from other sources such as cosmic rays and thunderstorms, detach electrons from oxygen and nitrogen atoms, producing a *plasma* of positively-charged ions and free (negative) electrons.

The free electrons interact with the electric field of a radio signal and can either absorb it or re-radiate part of it back to earth.

The frequency of the radio signal strongly affects how it interacts with the free electrons: VHF and UHF signals oscillate too rapidly for the electrons to follow closely, and pass right through to outer space. Lower frequency signals can reflect or be absorbed, depending on the density of free electrons.

The ionization of the air atoms is a fairly rapid process, occurring in seconds or minutes, so it occurs early in the morning as the sun comes up. If the solar radiation is blocked by an eclipse, the plasma can rapidly recombine back into neutral atoms.

The ionosphere comprises several distinct layers, historically named the F layer, the strongest and farthest out, with the E and D layers closer to the earth. The F layer persists day and night, but the E and especially the D layers are produced during the day and then disappear at sunset.

Radio Station WWVB

WWVB is a 60 kHz radio station in Fort Collins, Colorado that transmits, 24 hours a day, a standard time and frequency signal. It's what your "atomic" clock uses to set its own time. Propagation is by both groundwave and by skywave refracted off the ionized layers in the ionosphere.

During the day, the signal is both refracted off and absorbed by the D layer, and is usually quite stable.

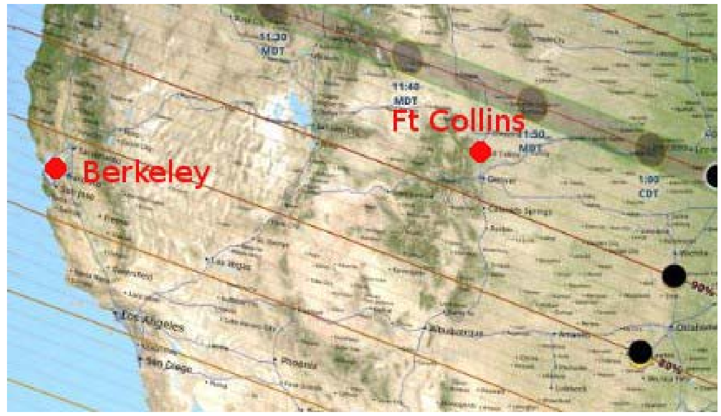
In fact, from day-to-day, the transmission time to the Bay Area is stable to around one microsecond consistency, measured at two points in time separated by 24 hours. Between sunset and the following sunrise, when the D layer disappears, the signal refracted off the E and F layers is much stronger, but due to the varying conditions, mainly due to thunderstorms around the world, the signal strength and propagation time can be strongly varying. In the Bay Area, multipath diffraction causes strong signal amplitude variation around sunrise and sunset.

As the daytime strength and propagation time of WWVB during the day are quite stable, measuring these parameters during the eclipse and comparing them to a baseline measurement taken over several days or weeks can give a picture of the changes in the ionosphere due to the partial blocking of sunlight during the eclipse.

The Eclipse

This once-in-a-lifetime event occurred 21 August 2017, sweeping from the Northwest to the Southeast of the United States. In the Bay Area, we experienced a 76% reduction in sunlight at 10:40 AM PDT (UTC-7). The Bay Area and WWVB are both on the same side of the path of totality, but one would expect that even so, some changes would occur in the ionosphere. Those living east of the Berkeley-Oakland hills actually had an opportunity to see partial totality; all we in the Bay Area saw were clouds and overcast.

Receivers



In Berkeley, I measured both the amplitude and time shift of the 60 kHz WWVB carrier.

The amplitude was measured by receiving the signal in a tuned loop antenna followed by amplifiers and a tuned Collins-Telettra RF voltmeter that was calibrated to give the signal strength at the antenna in units of microvolts per meter at the amplitude modulation peak.

The time shift of the 60 kHz carrier was measured by a Fluke 207-5 carrier phase tracking receiver, using an independent amplified 1-meter whip antenna, locked to a stable GPS time reference. The time shift of the carrier is measured relative to the GPS reference. The binary phase shift time code modulation of the signal that prevents phase lock was removed using a "dephaser" so that the tracking receiver could phase lock onto the 60 kHz signal.

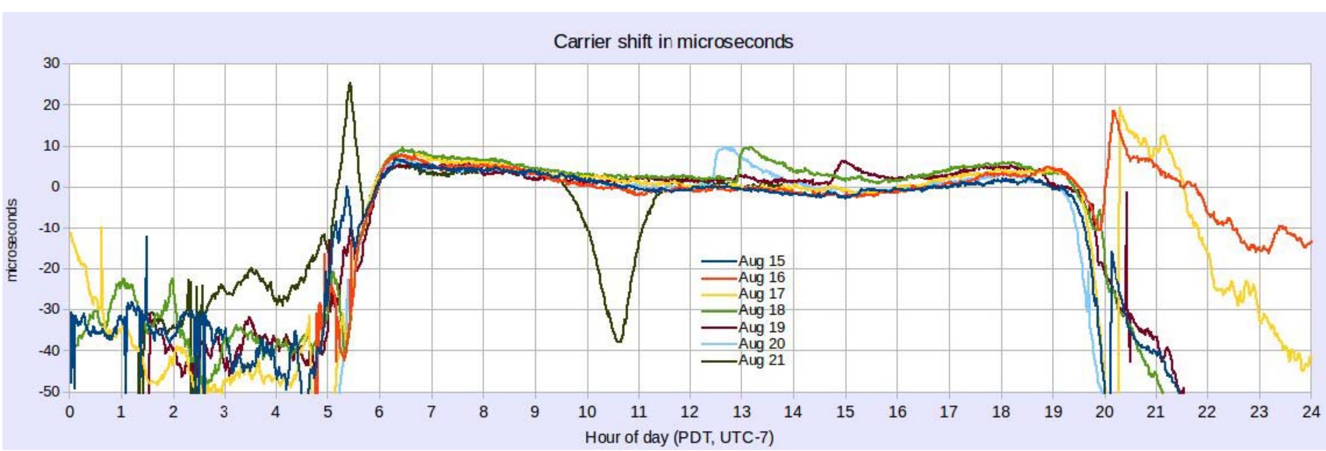
Both the amplitude and time shifts were sampled 20 times a second, and each minute 1200 of those samples were integrated and recorded. As the signal contains both amplitude and phase modulation, the long sampling time integrated out the 17 dB time code modulation, and the amplitude normalization represents the peak amplitude of the signal.

A baseline of the amplitude and signal timing was taken over a period of four weeks of continuous recording by a Raspberry Pi 3B microcomputer using two channels of a 10-bit MCP3008 ADC to convert the analog amplitude and phase signals to a digital data stream.

What I Saw

Previous data from others of receiving a VLF signal during an eclipse show no general trend other than the signal strength could be either greater or less during the eclipse. That indicates that multipath propagation is partly responsible for changes in signal strength.

The eclipse came and went, and I saw a small "blip" in the signal amplitude (the black curve) for 21 August, centered around 10:40 PM PDT.



The above figure shows the amplitude record of WWVB in Berkeley for a 1-week interval from 15 August 2017 to 21 August. Each 24-hour daily interval is overlaid on the same horizontal axis with units of hours Pacific Daylight Time (UTC-7), and the absolute signal strength shown on the vertical axis in units of microvolts per meter electric field strength at the modulation peak.

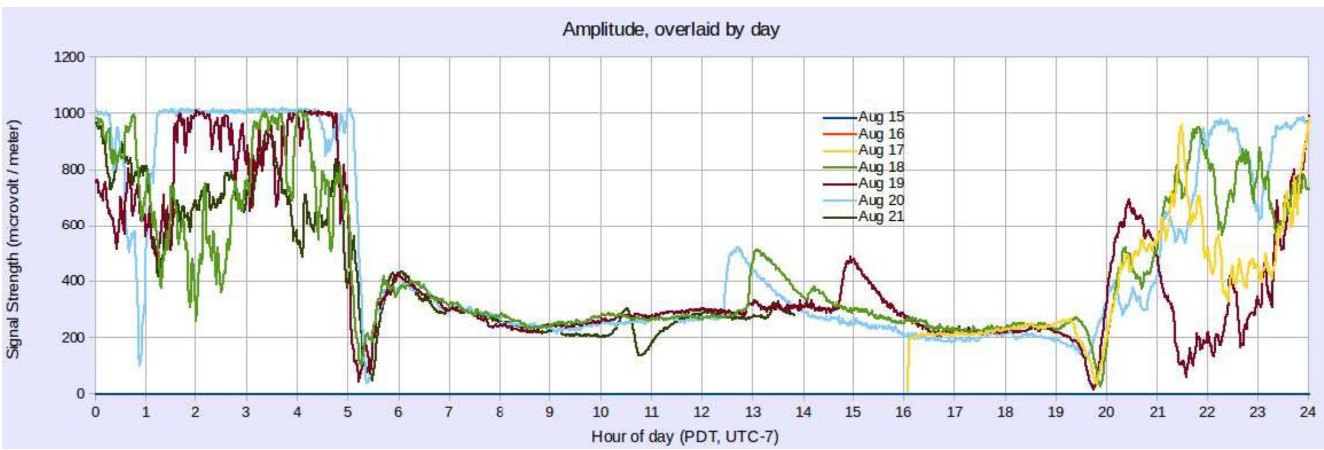
Note a dramatic signal strength drop around 5:15 and 19:45, approximately the sunrise and sunset times in Berkeley. The signal strength is much higher at night, and shows significant variability. Also note that the receiving equipment saturates at 1000 microvolts per meter.

During the day, the signal strength range is 200-400 microvolts per meter and very repeatable.

At 10:40 PDT the eclipse was at its maximum in Berkeley. Note the small "blip" around 10:40 PDT. Normally, the signal strength at that time is about 280 microvolts per meter. However, starting a little later than 9 AM, the signal strength dropped to 200 microvolts per meter, and then did a quick upswing and downswing at 10:40, returning to its usual value by noon. I can only attribute this to interference due to multipath, and another near observer might see something else.

Note also the signal strength blips on 18-20 August. These are due to SIDs.

The plot below shows the relative time shift of the WWVB carrier in units of microseconds, referred to a GPS time reference. As with the signal strength, between sunrise and sunset the phase of the received carrier repeats within a microsecond each day, and is quite erratic after dark. The time variation during the eclipse is the strong dip centered around 10:40 PDT.



The time variation was quite dramatic, approaching the day-night time shift of several tens of microseconds when the D layer disappears. The signal during the eclipse was delayed 39 microseconds from its baseline value at 10:40 PDT, indicating an increase in path length of 11.7 km, or 7.3 miles, due to the partial disappearance of the D layer and the signal refracting from the higher E layer during the partial eclipse.

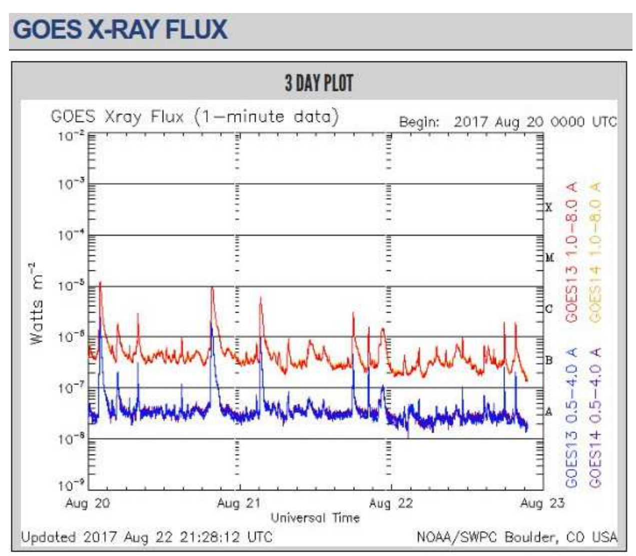
Sudden Ionospheric Disturbances (SIDs)

The amplitude and carrier shift plots for the dates of 18-20 August 2017 show sudden increases in signal strength and positive shifts in carrier phase. These are due to bursts of X-rays and ultraviolet radiation from the sun that increases the ionization level of the D-layer.

Increased ionization of the D-layer lowers the plane of reflection of the 60 kHz, effectively shortening the path length therefore advancing the phase of the received signal. Thus the sign of the time shift is opposite that of the eclipse event, where the D-layer ionization level is temporarily reduced.

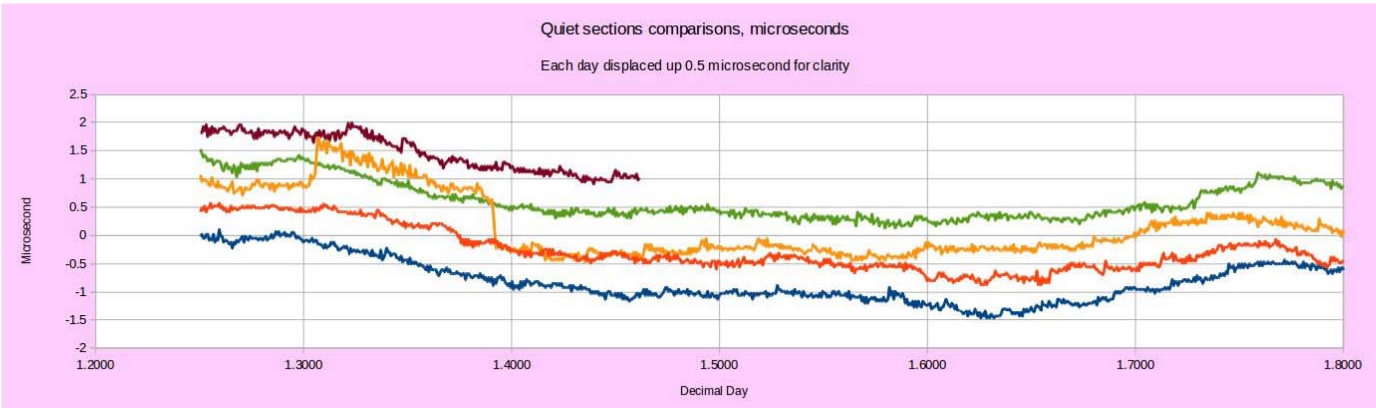
The signal strength is also increased during the SIDs events.

The plot at the right is a record of the solar X-ray flux recorded by the GOES13 satelllite, and the peaks correspond to the observations.



Antenna Work at WWVB Sensed

The plot below shows the carrier time shift record of WWVB from 17 June 2016 through 21 June, over the mid-day time span, as a function of a fraction of a decimal day (1.0, 2.0 = midnight, 1.5 = noon). (Each plot is displaced upward by 0.5 microsecond for clarity.) On the 20th (yellow line) an anomaly, starting about 7:20 AM PDT and lasting two hours shows a 0.8 microsecond advance in signal phase. What was that?



At that time, I speculated that the 0.8 microsecond offset looked too constant or the wrong time scale to be caused by a meteor or coronal mass ejection (CME), so is it from an event at WWVB itself? The station uses two top-loaded vertical antennas, 875 meters apart, each with its own transmitter, radiating a total of 50 kW. The two antennas are sited on a bearing line of 145 degrees. The effective center of the signal phase is located midway between the two antennas.

If the south (farther) transmitter ceases transmission for a trip condition or for maintenance, the phase center of the origin of the signal moves 251 meters closer to Berkeley, as it is now radiating from the north (nearer) antenna. The motion of the effective transmitting location 251 meters closer to Berkeley would result in a positive time shift of 0.84 microseconds, close to the observed value of 0.8 microsecond. Is this what happened?

The mystery was solved when Matt Deutch of NIST responded to an inquiry with:

> Howdy John,
>
> We did indeed have a problem. 2:13 p.m. PDT or 2113 UTC an intense thunderstorm passed over and we had 40 mph wind gust and what appears to be a direct hit from lightning. We were completely off the air for about 2 hrs and 10 minutes. Right after I restored the WWVB broadcast at 2325 UTC we were at about 60% power as the transmitters warmed up. I turned up the power later and we should have been at full power by 0000 UTC.
>
> You will be happy to know that your "wild speculation" was right on the money. I looked back in the records and we did do maintenance on our south antenna on that date.
>
> Matt

Earwigs

Things don't always go right. During the one-month baseline run, some anomalies started appearing in the amplitude record. The measured signal strength would lessen, but when the power to the equipment was cycled, the strength would come back up to normal.

The photo shows the loop antenna on a mast, suspended below the rotator, with the head-end preamplifier in the nearby enclosure.

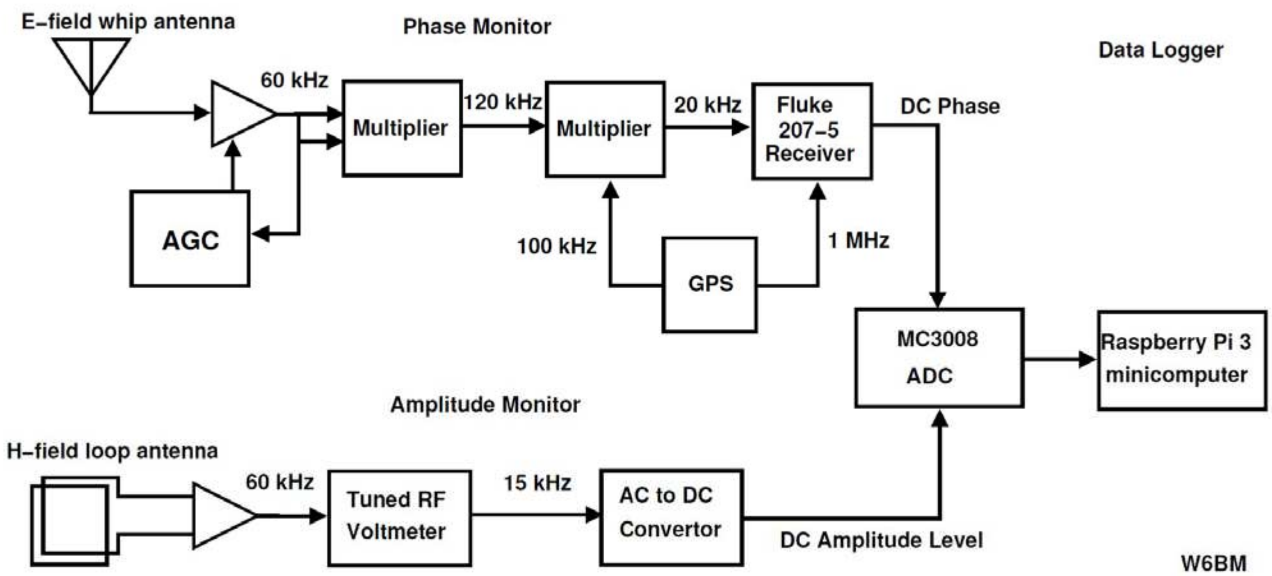
After all other possible causes were eliminated, the head-end preamp was demounted and opened up, showing a family of earwigs taking up residence. The preamp circuit includes a high input impedance FET first stage, and a small leakage from a resident insect could alter the bias of the first amplifier. The warmth of the components could have attracted the insects, who may have moved away when the power was cut.

Cleaning and reinstalling the preamp enclosure cured the problem.

Appendix

Some additional details of the receiver and data logger follow.

The WWVB data logging system comprises separate amplitude and phase channels, feeding analog data into an analog-to-digital converter (ADC) and minicomputer.



The phase monitor channel comprises an E-field 1-meter whip antenna on the end of the ham shack feeding a narrow-band 60 kHz amplifier whose output is leveled by a slow-responding AGC system.

The WWVB signal format contains time information encoded in two ways: by amplitude modulation of the carrier and by a bi-phase shift keying (BPSK), where the phase of the carrier is flipped by 180 degrees for each code bit. This phase shift prevents a phase-lock loop from locking onto an average carrier phase, which is required to determine long-term carrier time shifts.

One technique to recover absolute carrier time shifts is to remove the BPSK modulation by mixing the carrier with itself, doubling its frequency to 120 kHz, so 180 degree phase jumps become 360 degrees, indistinguishable from zero degrees. The output of the multiplier is 120 kHz, which is heterodyned with a GPS-derived

100 kHz carrier to produce a mixer product of 20 kHz, which within the tuning range of the Fluke 207-5 tracking receiver.

The signal amplitude is measured by receiving the signal with a 90-turn 1-meter diameter loop antenna. The resonant frequency of the loop is 78 kHz, and the loop gain is calculated from first principles from its geometry. When the loop is tuned to 60 kHz by a shunt capacitor, a 4.7 dB increase in signal strength is obtained. The loop is followed by a cascade of two preamplifiers, one at the loop, and one inside the ham shack, each with a gain of 20 dB at 60 kHz.

The signal strength is measured with a Collins-Telettra dual-conversion RF voltmeter, covering a frequency range of 4 to 750 kHz, with an IF output frequency of 15 kHz. The RF voltmeter IF output is followed by a linear RF-to-DC converter, the resulting DC level proportional to the received signal amplitude.

The data logger comprises a Raspberry Pi 3B running Ubuntu Linux 15.10. A MCP3008 8-channel 10-bit ADC is directly coupled to the 40-pin GPIO connector using a serial peripheral interface bus communications protocol. Only four connections to the Pi are required: chip select, clock, data input and data output. A driver was written in C that has the calling format:

```
unsigned int readadc(int input_channel, int clock_pin, int mosi_pin, int miso_pin, int cs_pin)
```

that produces a 10-bit integer value of the input voltage at the specified input channel.

Each of the two analog inputs (amplitude and carrier phase) is sampled 20 times a second; each minute 1200 samples are averaged to one value and written to a time-stamped log file. These log files are further analyzed and displayed in a spreadsheet.

A full month of data was accumulated to establish a baseline for the diurnal amplitude and phase variations.

The Author

Dr. John Staples, W6BM, designs and builds particle accelerators at the Lawrence Berkeley National Laboratory. He received his Extra Class ham license and First Class Radiotelephone and Radar licenses in 1958. Besides being an avid collector of vintage electronics, he has been a passionate motorcyclist for over 50 years.

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A Simple And Successful Radio Eclipse Experiment

By Bart Lee, K6VK

On August 21, 2017 many radio enthusiasts became Eclipsians, to monitor the effects of the total solar eclipse on radio reception. CHRS radiomen in the VLF Interest Group, John Staples, John Stuart, Paul Shinn and I did so. See the map graphic of the eclipse path (figure 1).

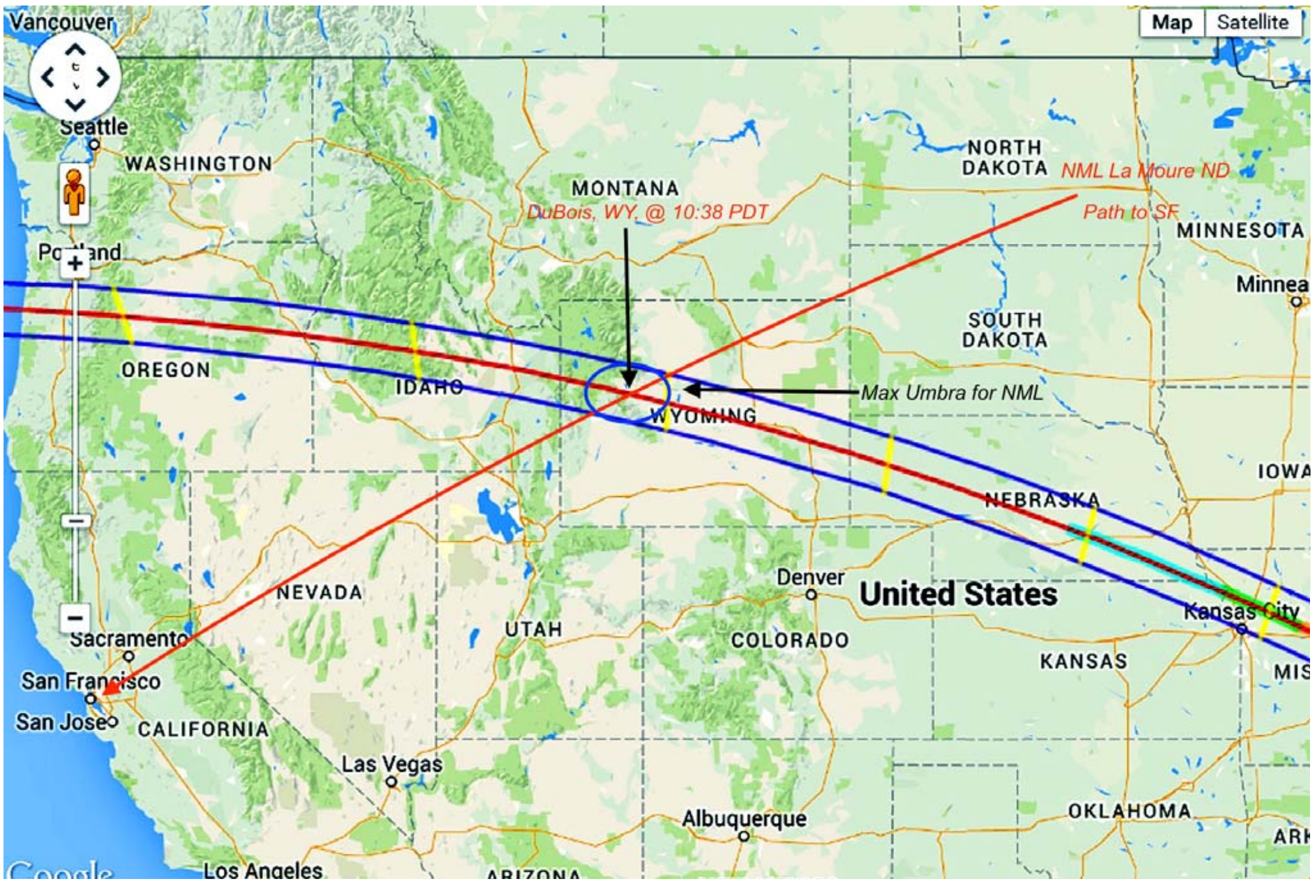

Fig. 1: Eclipse path.

U.S. Navy station NML in North Dakota transmits data at 25.2 KHz at high power. Its signal path to California crosses the path of totality. I estimated that the intersection would occur in the morning at about quarter to eleven, as shown on the map. A simple set-up produced the results recorded in the nearby graph (figure 2). The signal strength of NML doubled when the path of totality came between the transmitter and my receiver. Before this intersection, about 1.5 microvolts came down the antenna (the usual daytime strength). At the maximum cross of the paths, that shot up to 3.1 microvolts. That strength then decayed back to normal at about the same rate it had increased.

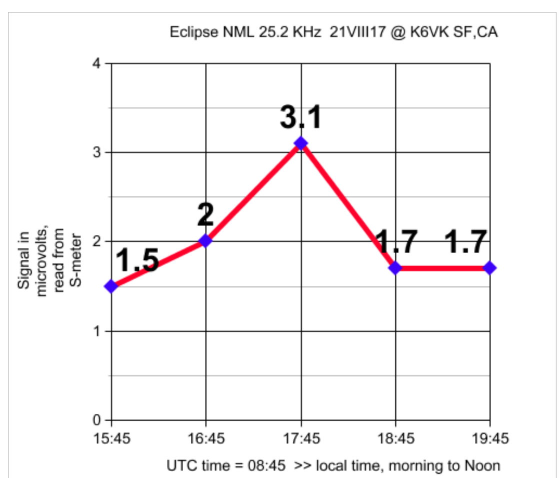

Fig. 2: Graph data from an iPhone — Time-Lapse of G33 SDR Screen.

To record the data, I set up my iPhone in a stable jig, pointed at the screen of my WinRadio G33 SDR (software defined radio). Set to time lapse, it recorded about 4 hours of display in 30 seconds of video. I pulled the numbers in the graph (figure 2) from that video.

John Stuart also recorded a jump in signal strength for NML, but with more precision. As set forth in the prior article, John Staples recorded WWVB on 60 KHz. Although that signal path was south of totality, major effects appeared. John Stuart also observed these effects on WWVB. Paul Shin monitored a long wave beacon some distance away from his home, both south of totality, and also noted an increase in signal strength. Gilles Vrignaud notes that the ARRL's *QST* magazine reported amateur radio experiments during an August 1932 eclipse (See QST January 1933 issue). European amateurs did long wave reception experiments in the 1970s. The consistent result is significant changes in signal strength. The ionized layer high above us, first postulated by Oliver Heaviside in 1902, seems still to be working just fine, even when challenged by a solar eclipse. Nearby is a screen capture of the NML signal at the maximum, 3.1 microvolts at about 10:40 AM (figure 3).

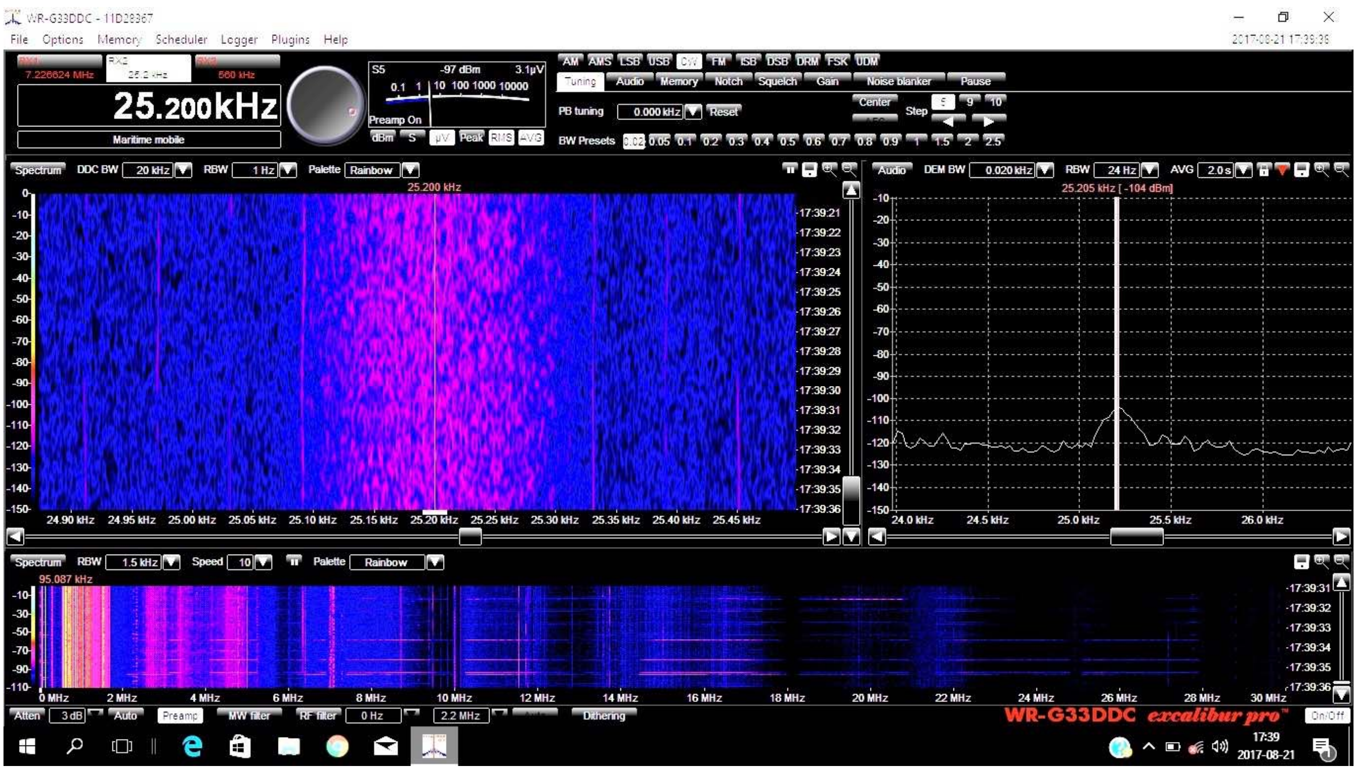

Fig. 3: Screen capture of the NML signal at maximum

The ARRL enlisted amateur radio operators to contact each other during the eclipse, on the several bands, for useful data. That has not yet been published. A group of enthusiasts, nationwide, known as the Eclipse Mob, set out to record WWVB, 60 KHz reception data during the eclipse. That too has not yet been published.

The CHRS VLF Interest Group investigates signals below the broadcast band, the longer wavelengths. This part of the spectrum is the Cradle of Radio, where it all began. Much of it is still in use for various purposes. Many general coverage receivers will reach down to VLF. Several companies sell inexpensive converters that move the frequencies of VLF up to 4 MHz. Antennas as simple as a vertical wire (albeit the higher the better) and a big one turn unshielded loop will capture many signals. Winter makes for the best listening on these long wave frequencies.

-- 73 de Bart, K6VK

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Zenith Wavemagnet

By Gary Sanders

Fig. 1: Zenith Wavemagnet label.

Around 1939, Zenith invented and patented the first *Shielded Wavemagnet* antenna for large table radios (figures 2 & 3). They introduced a new design in 1940 that was a vertical box, and rotatable for directional pickup. This was designed for consoles, and was now the *Zenith Shielded Rotor Wavemagnet*. It was covered with plain muslin and had a paper label (figure 1).

Fig. 2: Zenith Wavemagnet circa 1939.

Later in 1940, the Wavemagnet was put into a more decorative blue chipboard[1] box with bright orange lettering (figure 4). In 1941, the box was changed to a very distinctive metallic gold, red, black, and cream graphics that were right out of *Flash Gordon*, a popular comic and radio-serial of the time (figure 5). These changes helped to sell the radios in the showrooms of stores at the time, and probably excited the kids of the family, "Wow, Dad, let's get the radio with the cool box in the rear!"

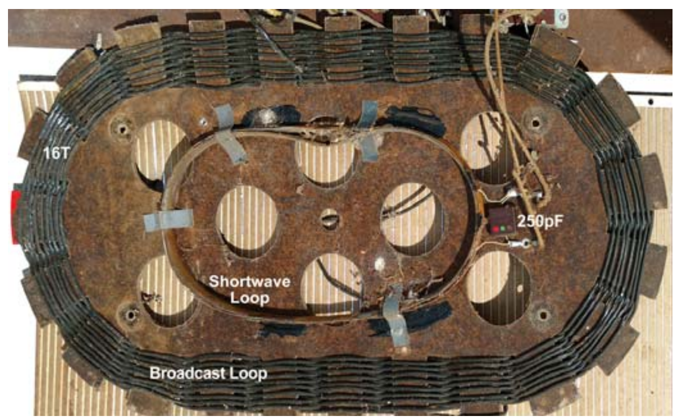

Fig. 3: Zenith Wavemagnet includes Shortwave and Broadcast loops.

But, why did Zenith invent the Wavemagnet? What was its purpose, and how did it benefit the radio consumer, and Zenith. Before the Wavemagnet, radios required a good earth ground connection,[2] and a long-wire antenna[3] mounted on the roof, or to a tree, limiting the location of the radio (figure 6). This was fine for enthusiastic early radio owners who were hobbyists; but too complicated for the average person as radios became widespread, or for someone living in an apartment. To avoid the added installation cost to their customers, Zenith wanted a built-in antenna that didn't require a ground so that the radio could be placed anywhere in a home or apartment. They wanted it "Plug-and-Play." As the label in figure 1 reads, the Wavemagnet eliminated the need for both the external antenna and earth ground. They called their invention the "Shielded Rotor Wavemagnet." When I first heard this, I said "What? How can a shielded antenna pick up anything?" It's a good point, and the Zenith engineers were no fools. To explain what they meant, we need to know a little about the nature of radio waves.

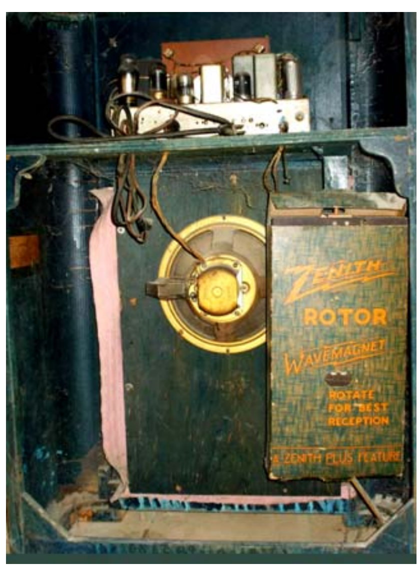

Fig. 4: Zenith Wavemagnet in blue box.

Fig. 5: Zenith Wavemagnet in gold box.

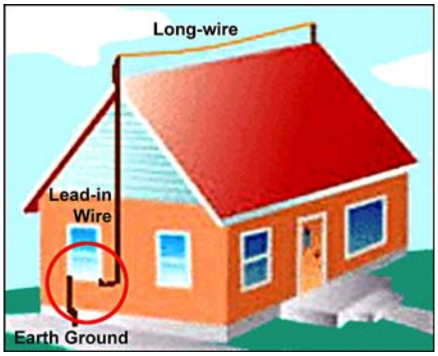

Fig. 6: Mounting long-wire antennas required considerable space outdoors which could be very inconvenient, especially for city dwellers.

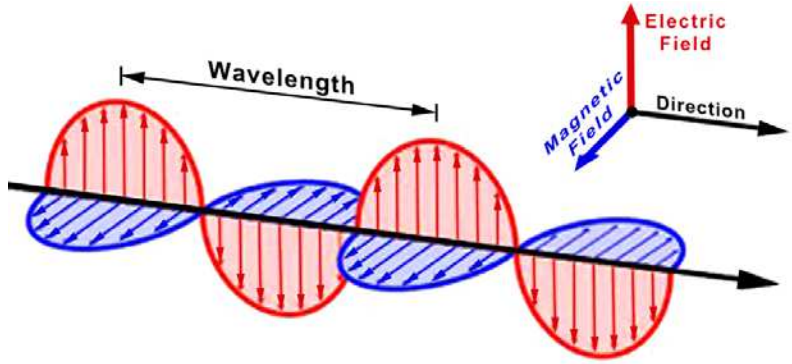

Fig. 7: The Electromagnetic wave has two components, a Magnetic Field and an Electric Field that are at right angles to each other. Source http://ffden-2.phys.uaf.edu

A radio wave is an *Electro-Magnetic Wave*, with two components. Referring to figure 7, the "electro" part is a traveling AC *Electric Field* (red) that has voltage with no current, and is high in impedance.[4] The "magnetic" part refers to a traveling AC *Magnetic Field* (blue) that has current with no voltage, and is low in impedance. These are AC fields because they are made up of the product of a high frequency RF carrier and its audio modulation. For simplicity, we only show the RF carrier. The two fields are in-sync with each other; they are maximum and minimum at the same time. Because *Power* = *Voltage* × *Current*, synchronized fields deliver power to the antenna and receiver. Maximum power is delivered when the impedance of the antenna and that of the radio input are matched. The electric and magnetic fields are also in quadrature[5] with each other. This is important to the operation of the Wavemagnet because the orientation of its windings can pick up or reject either field. Dipoles and long-wire antennas pick up Electric Fields; Loop antennas pick up Magnetic Fields (figures 8 & 9). Loop antennas have a high loss (about 50dB), more on this later.

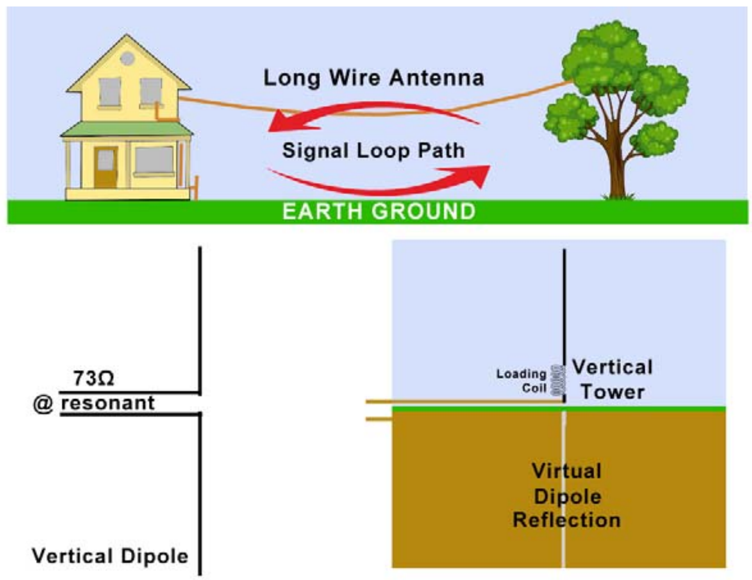

Fig. 8: Long-wire and dipole antennas pick up the Electric Field component of an Electromagnetic wave.

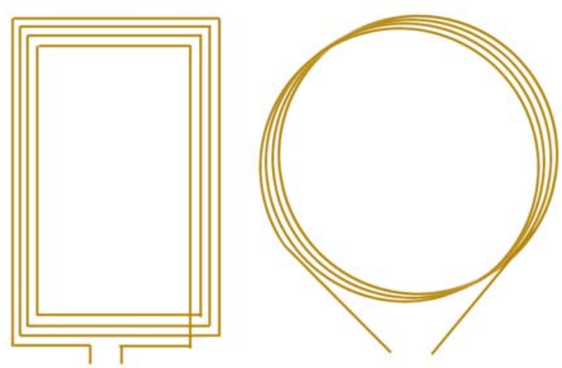
Fig. 9: Loop antennas that pick up the Magnetic Field component of an Electromagnetic wave.

Zenith assumed that a typical Broadcast transmitting antenna would be a vertical antenna utilizing a loading coil to provide resonance at a practical height. Today, we often see these antennas in sets of three. By varying the phase and amplitude of the signals to the antennas, you can create complex directional patterns to maximize reception and minimize required power to reach a given audience. A vertical transmitting antenna has a vertical electric field, and is vertically polarized.[6] Figure 10 shows the radiation pattern several wavelengths away from a vertical dipole antenna. Figure 11 shows the pattern of a complex vertical antenna several wavelengths from the antenna, and from a long receiving distance called the *Far Field*. In the far field, the fields of any antenna are a flat plane wave.

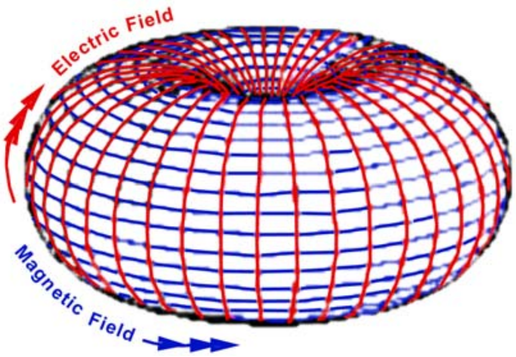

Fig. 10: The Fields of a vertical dipole antenna.
Source Wikipedia

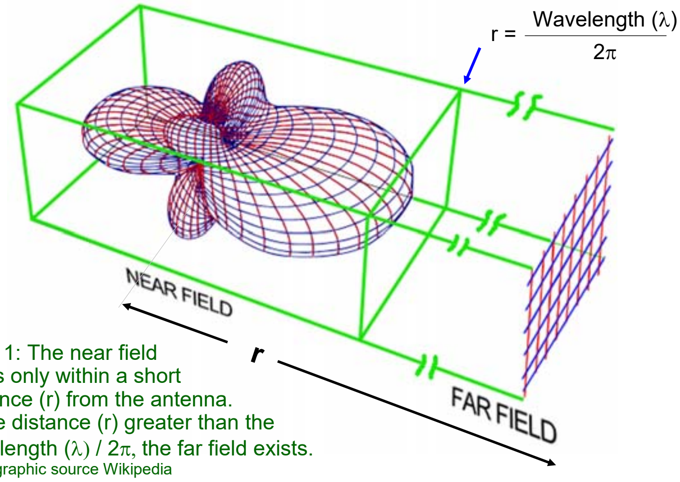

Fig. 11: The near field exists only within a short Distance (r) from the antenna. At the distance (r) greater than the wavelength (λ) / 2π, the far field exists.
Basic graphic source Wikipedia

What is the impedance of a radio wave? Near the antenna, the impedance is high because the Electric Field (Voltage) is strong and the Magnetic Field (Current) is weak; but at a distance (r) greater than 1/8th wavelength, the fields equalize with each other, such that the impedance is 377 ohms,[7] the impedance of *Free Space* (figure 12). An antenna should electrically match to the impedance of free space for maximum efficiency. Some antennas can convert the impedance. A vertical antenna is a virtual dipole using the earth as a mirror to create the other half. A resonant dipole has an output impedance of 73 ohms. For receiving antennas, we are only concerned with the far field, where the signal is a flat plane wave. For reference, the wavelength of 550 kHz is 1,818 feet, and is only 55.5 feet at 18 MHz. These are the typical low and high frequencies of tube consumer radios of the 1930's. These wavelengths are very long distances compared to any wiring in the chassis or in the Wavemagnet, they do not act as transmission lines.

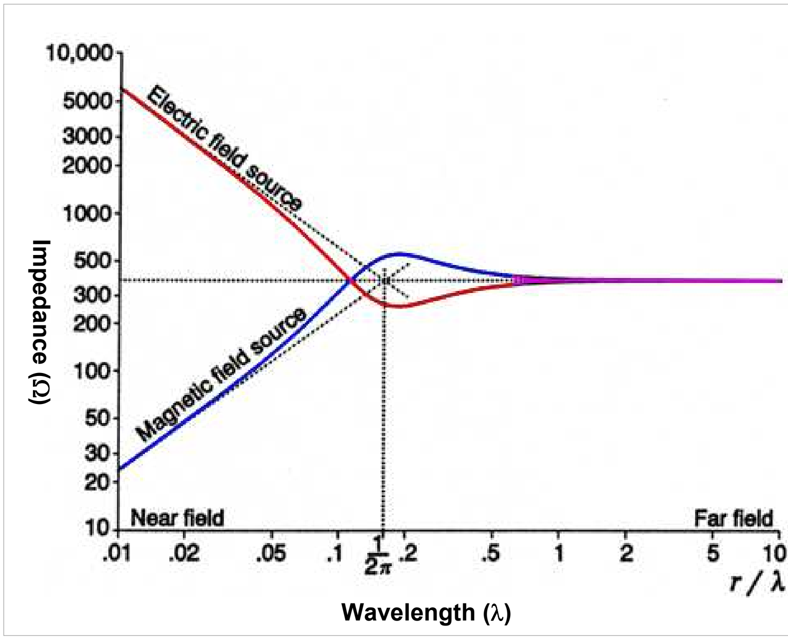

Fig. 12: At the threshold between the near and far fields, the impedances of the Electric Field and the Magnetic Field converges to the impedance of free space (377 ohms).

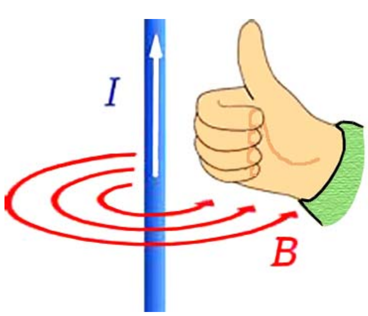

Fig. 13: The Right Hand Rule — a current in the direction I through a wire produces a magnetic field shown in red arrows. Source Wikipedia.

Zenith's loop is much smaller than the wavelength of the signals, and is referred to as a *Small Loop* that picks up best at either vertical edge of the loop, and rejects signals facing into the plane of the loop. The right-hand rule, shown in figure 13, shows that the horizontal magnetic field can be represented by the curling of the fingers of the right hand, and the thumb represents the current generated by the magnetic fields around the vertical wires of the loop.

Figure 14 shows two loop antenna orientations and how the right-hand rule explains the directionality of each. There is a lot of information in this diagram, but bear with me, it will explain a lot. The loop on the left is oriented with the RF Wave entering the edge of the loop. Note that the magnetic field is horizontal, and the right-hand rule says that a signal current will flow up each vertical side of the loop, meet at the top, and try to cancel. However, there will be a small phase shift, even at long wavelengths, that will make the two currents slightly different, and they will not completely cancel. The cancellation that does occur gives the loop antenna its high loss. The loop will pick up at a maximum from both edges, giving it the figure-8 pattern as shown in figure 15. The horizontal portions of the loop are oriented to pick up the electric field, shorted out by the loop, and are irrelevant.

The loop antenna on the right is oriented with the RF Wave entering the plane of the loop. The vertical sides of the loop, picking up the magnetic field, have no phase shift between them, in the middle, resulting in two currents i_0 and i_1 are identical and exactly cancel. This accounts for the nulls in the plane of the loop. Again, the loop picks up identically from both planes, with the figure-8 pattern shown in figure 15.

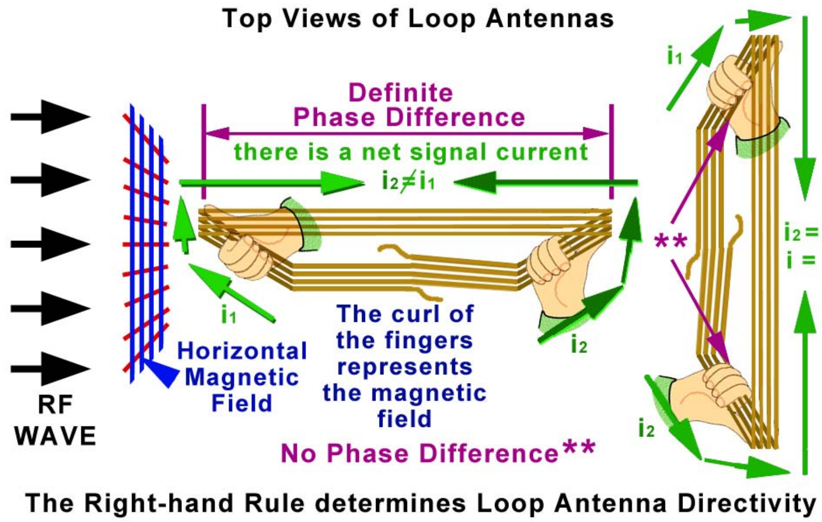

Fig. 14: The Right Hand Rule determines loop antenna directivity.

Larger loops will have phase shift across the plane of the loop and can pick up in more directions. Figures 15-17, taken from the book "Antennas" by John Kraus, McGraw-Hill 1950, show the directional pickup patterns, and how the pickup patterns vary for small, medium, and large loops.

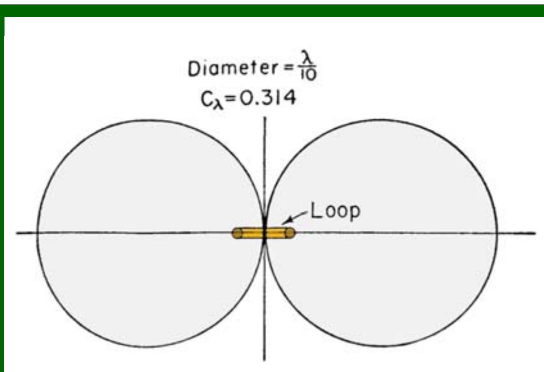

Fig. 15: Small loop directional pattern.

Loop antenna directionality.
Source "Antennas" book

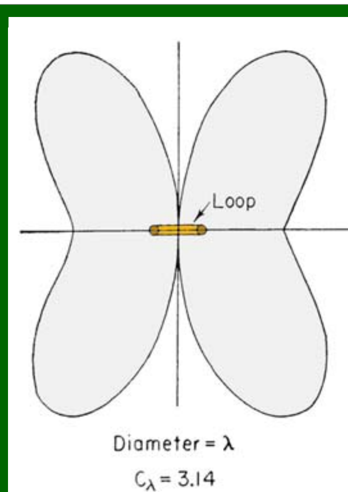

Fig. 16: Medium loop directional pattern.

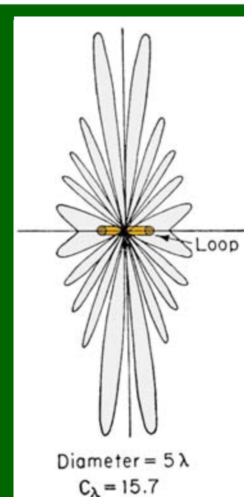

Fig. 17: Large loop directional pattern.

A long-wire antenna is unbalanced and requires an earth ground to develop clean radio signals. Due to the large height of the antenna above the earth, typically 10-20 feet, the impedance of the antenna is very high. The earth ground reference of the antenna is far from the radio chassis, so the chassis must have the same earth ground as the antenna to eliminate ground loop noise. An ungrounded radio chassis has a poor ground reference due to power transformer winding capacitance and the high inductance house wiring. Zenith engineers knew that a loop antenna built into the radio cabinet would allow a common ground reference for the antenna and the radio chassis, eliminating the need for earth ground. They also knew that a loop antenna can be resonated, creating a variable tuned circuit at the radio input. This is a simple preselector that maximizes gain and reduces images (birdies). A transformer is usually used to match the impedance of the loop to the grid of the input tube in the radio. Let's look at receiving noise, then put this all together.

When the antenna signals are fed to an ungrounded radio, the signals are masked by noise picked the voltage difference between the earth reference at the antenna and the floating ground of the radio chassis. Radio chassis' have two-wire power cords. By grounding the radio chassis to earth ground, the extra noise is not developed, resulting in clean reception. Radios without a power transformer add a hazard when grounding the chassis. Depending upon how the plug is inserted into the power outlet of the home, the chassis can have 120 Volts on it. Radios designed this way have no metal grounded parts that are accessible by the user. Knobs and switches are plastic or wood. The chassis ground connection may then be isolated with a series capacitor of 0.01uF with a 250VAC rating.

The first type of noise is static from summer lightning, sometimes hundreds of miles away; not much can be done about this. The second type of noise is generated in the home from electric motors, such as vacuum cleaners, drills, mixers, etc. These are high impedance electric field sources that consist of high voltages and very weak magnetic fields.

Loop antennas have a disadvantage due to their losses compared to long-wire antennas. This makes motor noise in the home more of a problem that must be solved. In the early Wavemagnets, an electric shield was created by the aforementioned metal foil pattern on chipboard panels that were mounted on either side of the loop antennas (figures 3 & 26). The foil patterns were grounded to the chassis through the short Wavemagnet cable. The electric fields from motor noise can have any orientation, so the orientation of the foil strips isn't important. In later Wavemagnets, this was replaced by a pair of widely spaced windings grounded at both ends. By applying several separated turns of a horizontal grounded winding around the loop, the electric field of noise sources will be grounded out, without affecting the reception of the magnetic field of the signal.

Zenith designed the Wavemagnet so that an external antenna would not be required for either AM Broadcast or Shortwave. Let's examine in detail the construction of a later rotatable Wavemagnet. Figures 18-20 shows the broadside of the antenna, and its three windings. These diagrams come in handy for repairing or rebuilding a Wavemagnet.

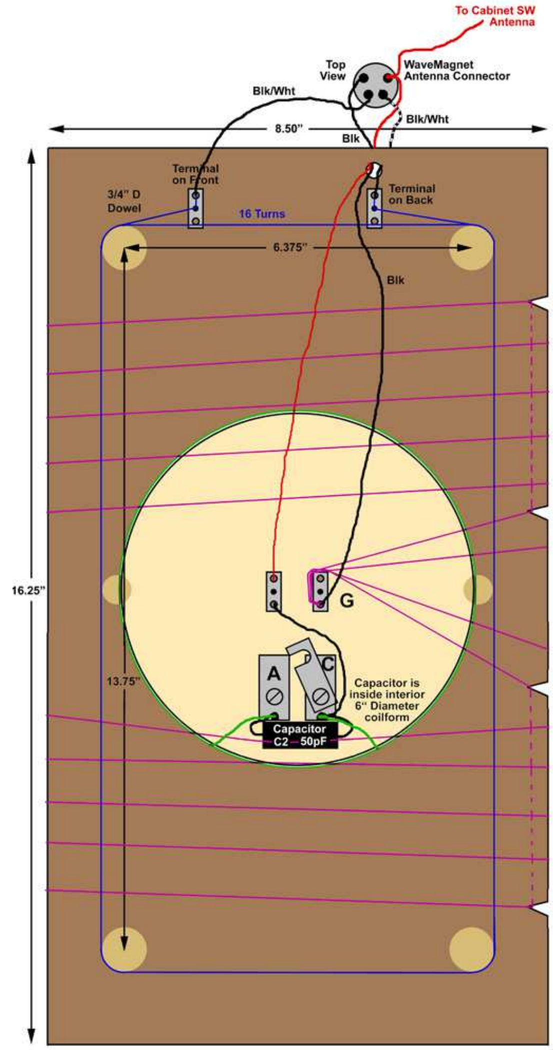

Fig. 18: Pictorial view of a Zenith Wavemagnet.

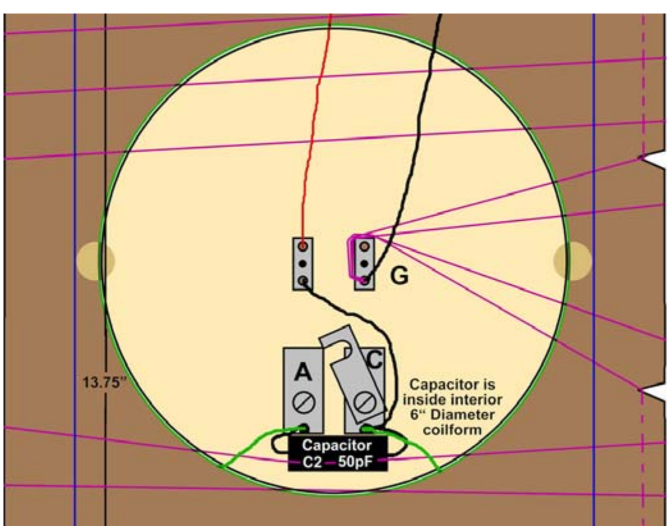

Fig. 19: Detail of the connections in the center.

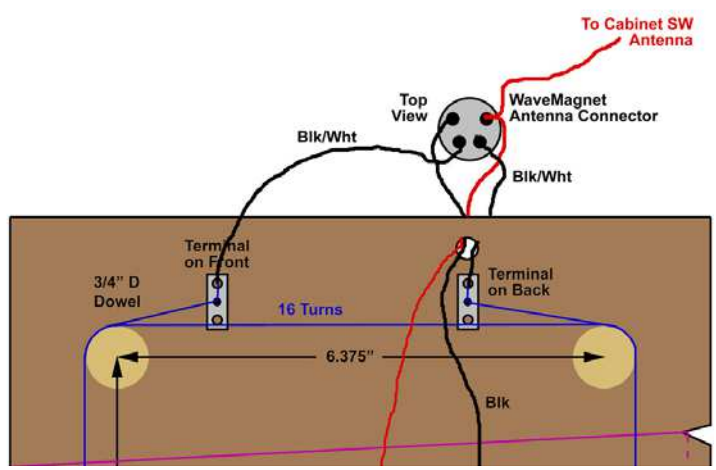

Fig. 20: Detail of the connections at the top.

Figure 21 shows the schematic of the front-end of a Zenith radio with a Wavemagnet. This diagram is difficult to interpret due to the complexity of the dual-section rotary switch which interconnects the circuitry. The next three schematics are simplified, showing only the connections for each of the three modes - Automatic, Broadcast, and Shortwave.

In the *Automatic* mode for Broadcast (figure 22), the pushbuttons are used for tuning. Each button switches in a variable capacitor to resonate the large Broadcast loop to the desired frequency, and a variable inductor to tune the oscillator to the correct frequency to tune the station. These two parts are not connected together because they have totally different functions. C1A and C1B, of the main tuning capacitor are not used in this mode. You program a button by tuning the desired frequency with the variable inductor, and peaking reception with the variable capacitor. A special tool was provided for this.

The *Broadcast* mode (figure 23), used the ganged Capacitor C1A to resonate the broadcast loop, and C1B to tune the oscillator. An external antenna could not be added for Broadcast because it would de-tune the antenna. This also applies to the Automatic mode.

The *Shortwave* mode (figure 24), disconnects the broadcast loop and connects the shortwave loop which is resonated through a transformer scaling down the capacitance of C1A. The shortwave loop also has a connection to a stranded wire antenna that winds around the inside of the cabinet. This wire connects to the Wavemagnet connector. There is a fixed capacitor across the loop to aid tuning. Only the Shortwave mode allows an external long-wire antenna, and a chassis earth

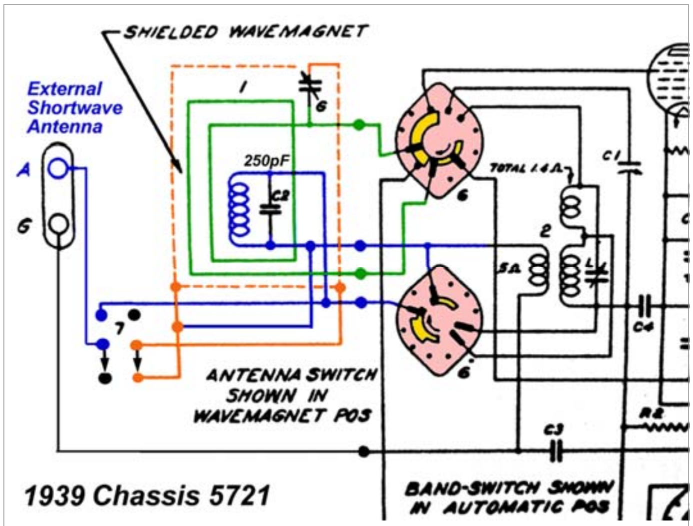

Fig. 21: Zenith schematic showing a portion of the RF section the band-switch and Wavemagnet .

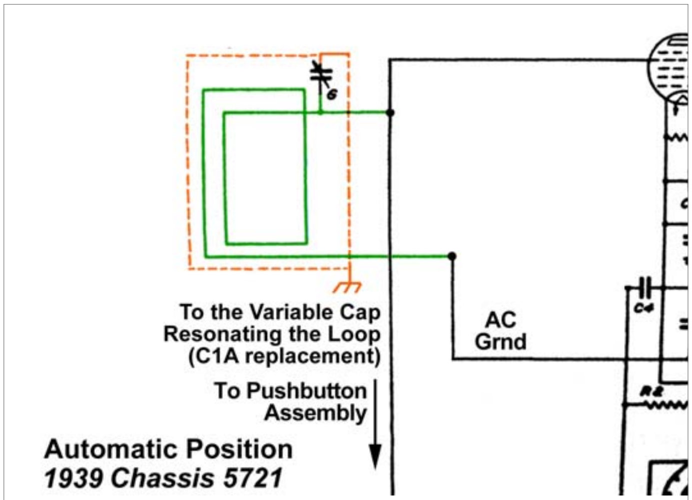

Fig. 22: Simplified schematic of the same radio showing the circuit with the band-switch in Automatic position.

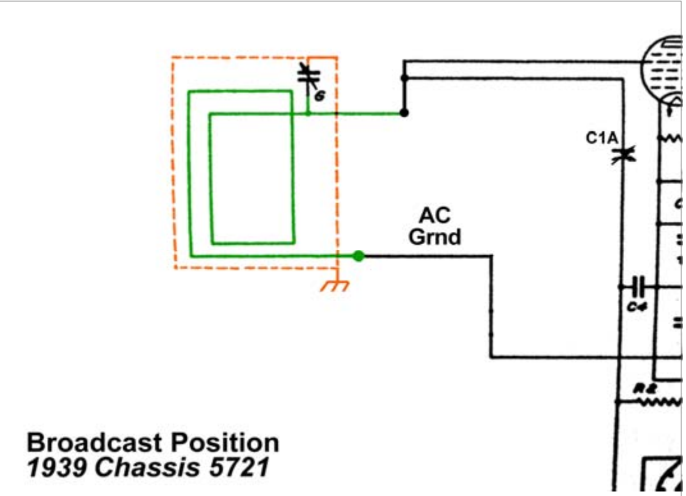

Fig. 23: Simplified schematic of the same radio showing the circuit with the band-switch in Broadcast position.

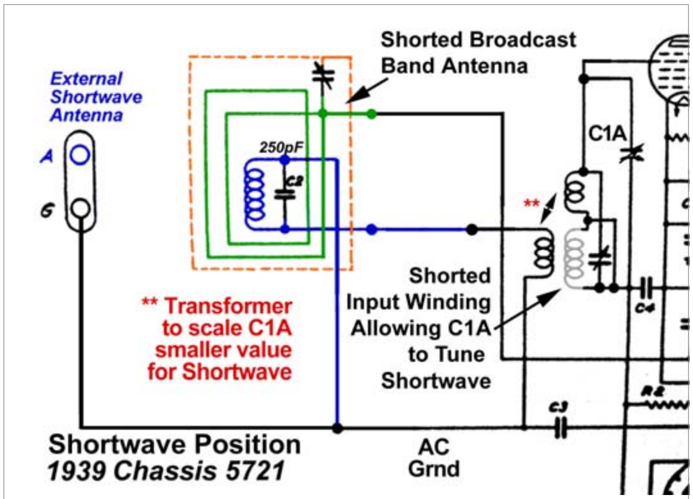

Fig. 24: Simplified schematic of the same radio showing the circuit with the band-switch in Shortwave position.

ground should be used to reduce noise. There is a shorting strip on the back of the Wavemagnet that can short the Shortwave loop when the external antenna is connected. This may improve reception.

Fig. 25: Zenith Wavemagnet with Local / Distance switch.

Zenith wanted the Wavemagnet to be easy to use; but they also wanted versatility, and they struggled to find the right balance between these two. Some early versions had a slide switch for Local/Distant (figure 25). This switch went to the chassis to control the voltage on one of the grids of the input tube. A better AVC circuit eliminated the need for this. There was sometimes a Wavemagnet/External Antenna slide switch for shortwave, later replaced by the shorting strip. There was a capacitor to tune the broadcast loop. Some versions did not have access to the external long wire antenna terminals; the terminals were there, but no screws.

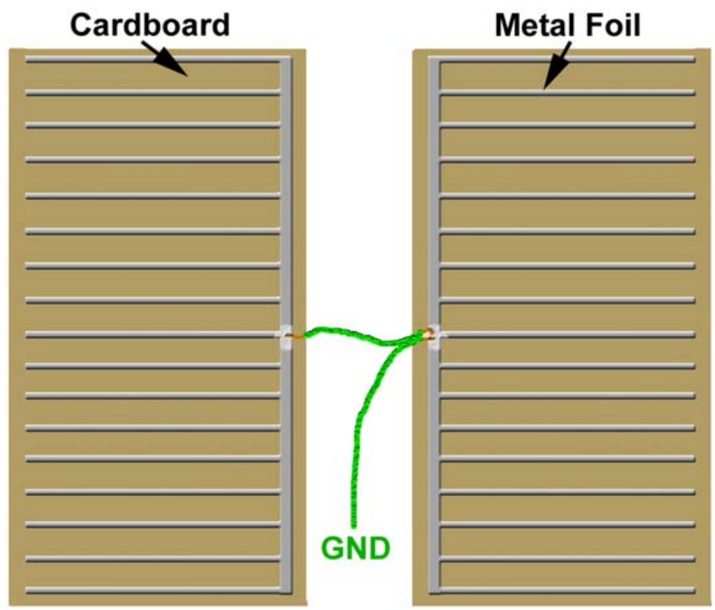

Fig. 26: Early Wavemagnet panels included grounded tin foil patterns.

The first Wavemagnet antenna was a large plain horizontal rectangular box, with two oval tuned racetrack loop antennas inside; one large for broadcast, and one small for shortwave, see Fig. 3. The front and back were plain Masonite panels, and a black chipboard strip around the sides of the antenna protected it. Within the Masonite panels, on each side of the loops, were two additional chipboard panels with grounded tin foil patterns (figure 26). The chipboard panels with foil were replaced with a pair of widely-spaced horizontal turns of grounded wire, saving cost.

The AM broadcast loop became a large rectangular loop, and the shortwave loop became round. During 1941-42 There were many versions of the Wavemagnet as Zenith struggled to find the right combination of features and ease of use. In consoles, it was called the Rotor Wavemagnet because it was mounted such that it could rotate to face the station. In chairside and large table radios it did not rotate. There was a cable that connected to the chassis. The Wavemagnet was an important step forward in technology at the time.

Current Zenith Wavemagnets are now 75 years old, and the cardboard boxes are all faded, and most have moisture damage and missing pieces, with tears, chips, and stains. I invite you to visit our website zenithwavemagnet.com and register for updates of our crowdfunding of 500 perfect replicas of the metallic gold Wavemagnet box. Figures 27-28 show photos of our prototype. The final product will use metallic gold. There is also a free video and slideshow about the Wavemagnet. The crowdfunding is a way to pre-sell the new boxes at a 25% discount of the retail price. For those who would like to support this project, but don't need a box, there will be T-shirts.

If we exceed our goal, we may be able to produce the blue and orange version (figure 29).

Zenith Wavemagnet reproductions offered at ZenithWavemagnet.com

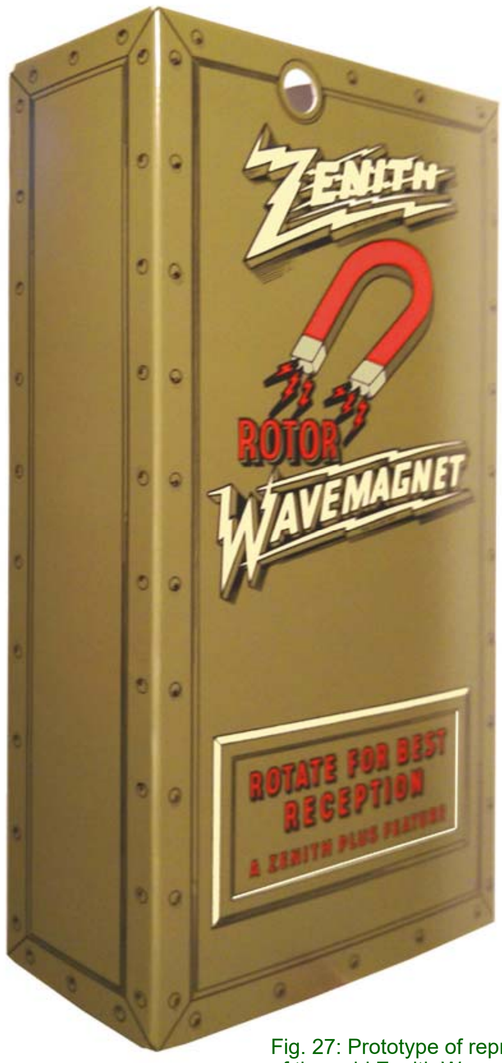

Fig. 27: Prototype of reproduction of the gold Zenith Wavemagnet .

Fig. 28: Reproduction gold Wavemagnet top view.

Fig. 29: If there is enough interest, a blue and orange version may offered as well.

Notes:

1. A dense stiff non-corrugated cardboard, like a board game box or thicker.
2. An 8’ copper plated steel rod was pounded into the earth near a window close to the radio.
3. Usually a 50’-75’ stranded copper wire, with an insulated lead-in wire soldered to it.
4. Ohm’s Law $V = I \cdot R$, or for our purpose $V \div I = R$ (or Z). Resistance is R, and Impedance is Z (Z is Resistance plus Reactance from Capacitance and/or Inductance. If this sounds “complex”, it is :-).
5. Quadrature means 90˚ with respect to each other, or *orthogonal* if you like $5 words.
6. Polarization is based upon the direction of the Electric Field.
7. The impedance of free space, Z_0 equals $120\pi\ \Omega$ or $\sqrt{(\mu_0/\varepsilon_0)}$ where μ_0 is the permeability of free space in henrys per meter (H/m); and where ε_0 is the permittivity of free space in farads per meter (F/m).

Gary has a B.S.E.E. in Electrical Engineering from Rose-Hulman Institute of Technology. He is a Member of AES and holder of 3 patents. He's an enthusiast in Vintage Radio, Amateur Radio KG6JQR, Old Mystery Movies, Classical Music, and Musical Theater.

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Radioland

By Jason Vanderhill

This is an article written for the Fraser Valley Antiques & Collectibles Club (FVACC) newsletter about a very rare radio manufactured in Oakland, California. The FVACC is located in British Columbia, Canada. The radio is part of a collection of a FVACC club member and club historian, Al Reilly.
Mr. Reilly is seeking a schematic of this radio; if you have one, please let me know and I will forward it to him.

The Editor

One of the more elusive radios in Al Reilly's collection is this early Radioland brand. Just try to find an ounce of information online about this obscure radio, and you will soon be pounding your fists in frustration! There are 379,000 Google results, and virtually all of them refer to the 1994 film by that title, or magazine from the 1930s, or any number of other peripheral hits. But few come close to explain the origins of this machine.

Thankfully, I was able to extract some clues from the radio itself, and I narrowed down my search to Oakland, in the mid 1920s. It was the instruction card inside the radio that tipped me off. The listing of early radio stations started with KGO, an Oakland station (for no apparent reason) and it ended with a station from Catalina Island, KFWO, a 250-watt station that operated between 1925 and 1928. Searching through the Oakland Tribune, I began to piece together the origins of the Radioland brand.

Robert Land Radio Co. is first advertised in the Oakland Tribune, starting around the fall of 1924, and by June 1925 he is announcing the opening of a new store. In late 1925, he begins to use the Radioland brand. His advertisements continue up to at least 1929. His business, the Robert Land Radio Co. is also listed in directories at least up to 1929, and although the Great Depression may have had an impact on his operations, it seems he continued to work up until his death on January 23, 1933. He died three months shy of his 52nd birthday.

Front panel of the Radioland set.

Interior of the Radioland set — Fine American craftmanship!

With some assistance from Neil Whaley, I was able to uncover some more biographical information about our Robert Land. He was born April 21, 1881, and his parents were Howard Bradley Land (b. May 30, 1845) and Emma Frances Thwing (b. March 18, 1855), who married April 17, 1877.

Robert Land's marriage to Ann G. O'Leary was announced on July 20, 1910 in the Oakland Tribune. Their first son Robert Howard Land was born June 13, 1911, but tragically, he died at age 1 year, 7 months, and 4 days on January 17, 1913 in Oakland, California. No cause of death is noted.

The radio advertisement of Dec 3, 1926 (next page) features a comparable radio, the Stewart-Warner brand radio, Model 300. It sold for just over $100, more like $1,400 today. We can presume that Robert Land's own brand, the Radioland model, was sold at a more competitive price, and perhaps gave him a better profit margin. But without actually seeing his books, it's still a mystery how many of these radios were made, and if he turned a profit with them.

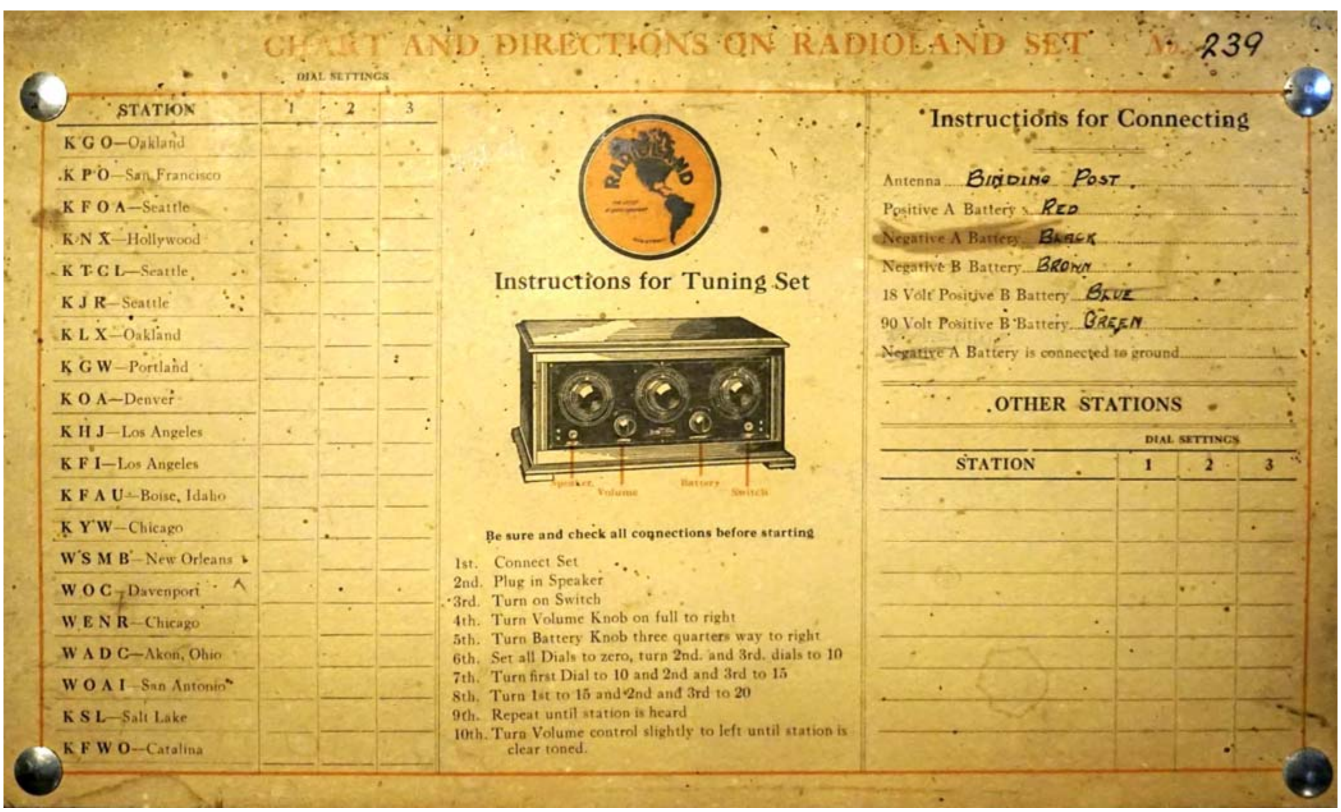

CHART AND DIRECTIONS ON RADIOLAND SET No. 239

STATION	Dial Settings 1	2	3
K G O—Oakland			
K P O—San Francisco			
K F O A—Seattle			
K N X—Hollywood			
K T C L—Seattle			
K J R—Seattle			
K L X—Oakland			
K G W—Portland			
K O A—Denver			
K H J—Los Angeles			
K F I—Los Angeles			
K F A U—Boise, Idaho			
K Y W—Chicago			
W S M B—New Orleans			
W O C—Davenport			
W E N R—Chicago			
W A D C—Akon, Ohio			
W O A I—San Antonio			
K S L—Salt Lake			
K F W O—Catalina			

Instructions for Tuning Set

Be sure and check all connections before starting

1st. Connect Set
2nd. Plug in Speaker
3rd. Turn on Switch
4th. Turn Volume Knob on full to right
5th. Turn Battery Knob three quarters way to right
6th. Set all Dials to zero, turn 2nd. and 3rd. dials to 10
7th. Turn first Dial to 10 and 2nd and 3rd to 15
8th. Turn 1st to 15 and 2nd and 3rd to 20
9th. Repeat until station is heard
10th. Turn Volume control slightly to left until station is clear toned.

Instructions for Connecting

Antenna Binding Post
Positive A Battery Red
Negative A Battery Black
Negative B Battery Brown
18 Volt Positive B Battery Blue
90 Volt Positive B Battery Green
Negative A Battery is connected to ground

OTHER STATIONS

STATION	Dial Settings 1	2	3

Chart and Directions included in the set. In the center section are Instructions for Tuning Set.

Radioland logo.

There's no clear indication yet if Robert Land's family tree is in any way associated to Edwin Land, inventor of the Polaroid camera. Edwin was an only child, and his parents were from the East Coast, but there's always a chance the families could be related, if you trace the roots far back enough.

All told, uncovering the back-story to this radio was a fascinating journey into the earliest days of the radio marketplace. Considering it does not seem that anyone has written about Robert Land's Radioland before, we can proudly say we've scooped this lost radio tale out of the ether, and we're sending it back to you over the Interwebs! For your enjoyment, below are a few more period radio advertisements from the Radioland era.

Radioland newspaper clippings. Source Newspapers.com.

Oakland Tribune, Oct 19, 1924

Oakland Tribune, Jul 15, 1926

Oakland Tribune, Jun 14, 1925

Oakland Tribune, Dec 3, 1926

Oakland Tribune, Nov 29, 1925

Jason Vanderhill is a digital curator, writer, and photographer in Vancouver, British Columbia, Canada.

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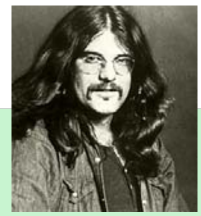
Bay Area Radio Hall of Fame — Class of 2017

FROM THE BIRTHPLACE OF BROADCASTING
BAY AREA RADIO MUSEUM
CALIFORNIA HISTORICAL RADIO SOCIETY

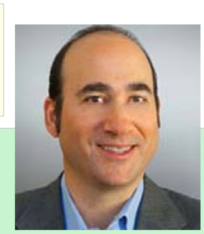
The 12th Bay Area Radio Hall of Fame inductees were honored Saturday, Sept. 23, at the Basque Cultural Center in South San Francisco, produced and hosted by the California Historical Radio Society and the Broadcast Legends. Here is the Class of 2017:

Program host: Dan Sorkin was a morning radio star in Chicago when he got fired in the early '60s for defending Lenny Bruce. He moved to San Francisco and KFRC, a rival of market leader KSFO. His ratings against Don Sherwood were impressive enough that KSFO hired him away. His career was shortened by a motorcycle accident in 1968. After losing a leg, he founded a support group for amputees: Stumps R Us. He died last June.



Program host: Richard Gossett was a fan of Bay Area Top 40 radio as a youngster, but became a model of the laid-back FM DJ on free-form radio when he worked on KSAN through the '70s. When KSAN changed formats, he moved on to stations including KUSF, KTIM, KKCY ("the City"), KQAK, KFOG and KRCB. He also was a brewmaster at Anchor Steam Brewing Co.

Talk show host: Michael Krasny has hosted the interview program "Forum" on KQED-FM for 23 years, since moving over from KGO. He also is an English professor at San Francisco State University, and an author ("Off Mike," "Sound Ideas," "Spiritual Envy" and "Let There Be Laughter: A Treasury of Great Jewish Humor and What It All Means").



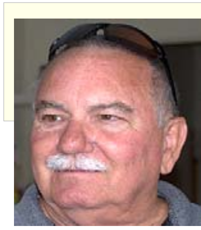
News: Doug Sovern has won more than 200 journalism awards for his work as a reporter, first on KGO and, since 1990, on KCBS, where he covers politics and does investigations and features. His awards collection includes five national Edward R. Murrow Awards. Sovern played bass for the CBS house band, the Eyewitness Blues Band.

News: Peter Cleaveland is known for his work in KGO's news department from 1967 through 1975. He also contributed reports to ABC Radio News. He moved to KGO-TV in 1975 until 1980, when he became a correspondent for ABC News. He also was an organizer for the American Federation of Television & Radio Artists AFL-CIO.

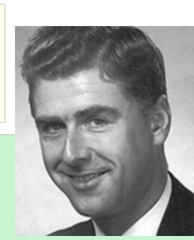
Sports: Rich Walcoff was at KGO from 1984 until he was let go, along with numerous Cumulus colleagues, early in 2016. By then, he was the station's sports director and morning sports anchor. He also co-hosted 49ers postgame shows. He got his start in the early '70s at the University of Connecticut, where he did play-by-play for the university's sports teams.

Specialty: Lee Jones, the engineer and producer behind the Giants broadcasts until he retired last year, logged 43 years on KNBR. In 1974, it was a music station, and Jones was a board operator. Between baseball campaigns, he did similar work for Warriors and 49ers broadcasts. Jones himself did some play-by-play, but only in the Army the late '60s.

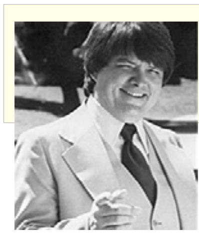
Management: Ron Fell is inducted for his work as program director of KNBR (1971-75), but the S.F. State graduate also wrote for the radio industry publication the Gavin Report, later becoming the magazine's principal owner and publisher. He also produced programming for the Oakland Raiders network from 1967 to 2010.



Engineer: Dan Ethen began as a teenage volunteer at KPFA in Berkeley in the '60s. His first paying radio job was at KLOK in San Jose, where he was on-air as well as behind the scenes. His other credits range from KNBR and KFRC to KSRO in Santa Rosa. Ethen works with the Educational Media Foundation, the Christian music broadcasters.



Pioneer: Tony Tremayne was his radio name, forced onto him by management at KYA. His real name was Mel Fritze, and he was born in Sacramento in 1922. He began at KROW in Oakland and worked at KTIM and KSFO before joining KYA in 1959 as a Top 40 DJ. He moved into the news department in 1962 and remained at KYA until he retired in 1980. He died in 2004.



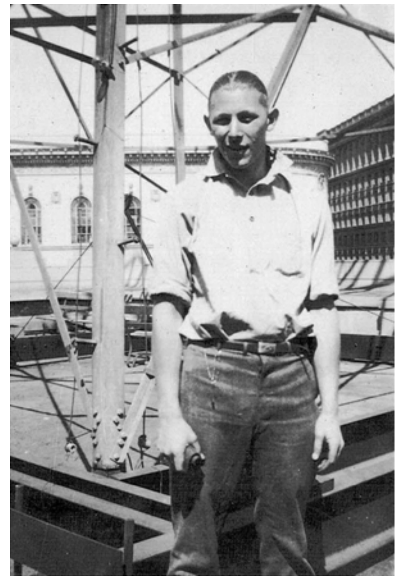
Don Sherwood Award (Legend): John Mack Flanagan was a big presence on KFRC ("the Big 6-10") when it was a Top 40 powerhouse in the mid-'70s. Despite high ratings, he left in 1979 over salary issues. He went on to KWSS, KIOI, KSFO/KYA, and KBGG ("K-Big"). He published his memoirs, "Tight & Bright: A Disk Jockey-Vietnam Memoir," last year.

Don Sherwood Award (Active): Chris Jackson, the morning host on KUFX ("K-FOX"), won the Sherwood Award in the "active" category and will be recognized for topping the poll as "the most popular on-air personality in Bay Area radio." ◊

Historic Radio Photos — Carl Christensen

By Len Shapiro

CHRS is place for all things radio! The Bay Area Radio Museum is the place for the history of Radio. We have obtained some great family and radio show scrapbooks over the past year. First, KYA engineer Carl Christiansen family donated a collection of photos and written history of his 50 years in Bay Area radio. KPO-KNBC-KNBR promotion director Jane Morrison donated her treasure trove of studio and announcer photos covering 1930-1970. Then, the Bill Sweeney family sent us three tremendous scrapbooks regarding the Breakfast Gang show featuring BARHOF member Mel Venter and his wacky cast of characters that was broadcast from KFRC studios both locally and on the Don Lee Mutual West Coast network of 46 stations from 1948 to 1957. We will feature photos and stories from all these great collections in future CHRS Journals.



Carl Christensen at KPO in 1927.

We will start with the oldest material. Carl Christensen began his radio career in 1925 after working as a Western Union messenger and hanging around new radio station KPO at the Hale Building at Market Street and 5th. He obtained his "radio license" on September 23, 1925 and was hired by KPO as a remote engineer.

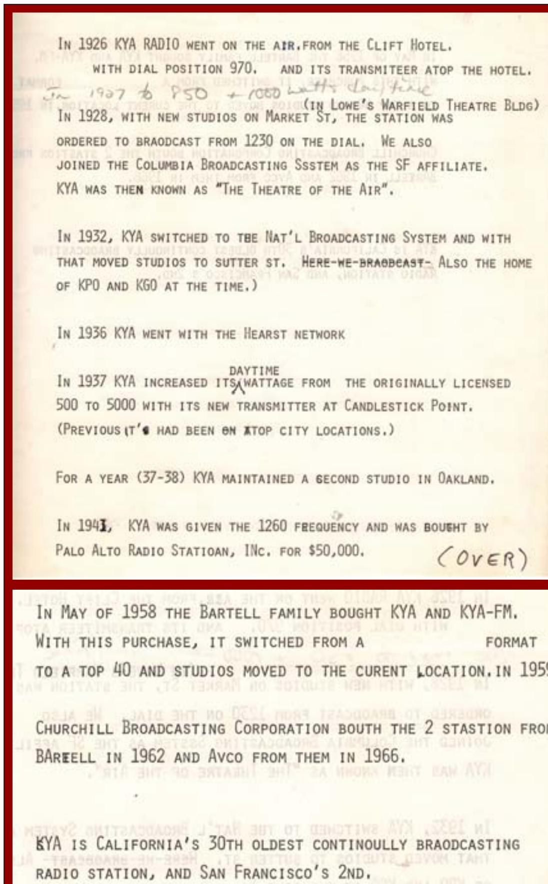
In 1927, Carl was hired by KJBS to be an announcer and engineer. The station was located on the second floor of Julius Brunton and Sons battery shop at 1380 Bush St. He quit KJBS in 1928 to return to KPO for the lofty salary of $150 per month. This lasted until 1930 when he tried another business.

Then in 1934, after bouncing back and forth from KJBS and KPO for two years, Carl was hired by KYA to do remote engineering. He would become a studio announcer seven months later and start his 43 year association with KYA.

Thank goodness Carl was an amateur photographer, as he chronicled the history of KYA studios and employees over the years. If you see a KYA photo on other websites, it's probably one of Carl's photos. KYA was designated the BARHOF Legendary station of the year in 2016.

Here are some of the photos featured in the Christensen collection.

Carl Christensen at Nob Hill KYA studios in the mid-1950s.



In 1926 KYA RADIO went on the air. from the Clift Hotel.
with dial position 970. and its transmiteer atop the hotel.
In 1927 to 850 + 1000 watts daytime
(in Lowe's Warfield Theatre Bldg)
In 1928, with new studios on Market St, the station was
ordered to braodcast from 1230 on the dial. We also
joined the Columbia Broadcasting Ssstem as the SF affiliate.
KYA was then known as "The Theatre of the Air".

In 1932, KYA switched to tbe Nat'l Broadcasting System and with
that moved studios to Sutter st. ~~Here-we-braobcast-~~ Also the home
of KPO and KGO at the time.)

In 1936 KYA went with the Hearst network

In 1937 KYA increased its daytime wattage from the originally licensed
500 to 5000 with its new transmitter at Candlestick Point.
(Previous it's had been on atop city locations.)

For a year (37-38) KYA maintained a second studio in Oakland.

In 1941, KYA was given the 1260 frequency and was bought by
Palo Alto Radio Statioan, Inc. for $50,000. (OVER)

In May of 1958 the Bartell family bought KYA and KYA-FM.
With this purchase, it switched from a format
to a top 40 and studios moved to the curent location. In 1959

Churchill Broadcasting Corporation bouth the 2 stastion from
Bareell in 1962 and Avco from them in 1966.

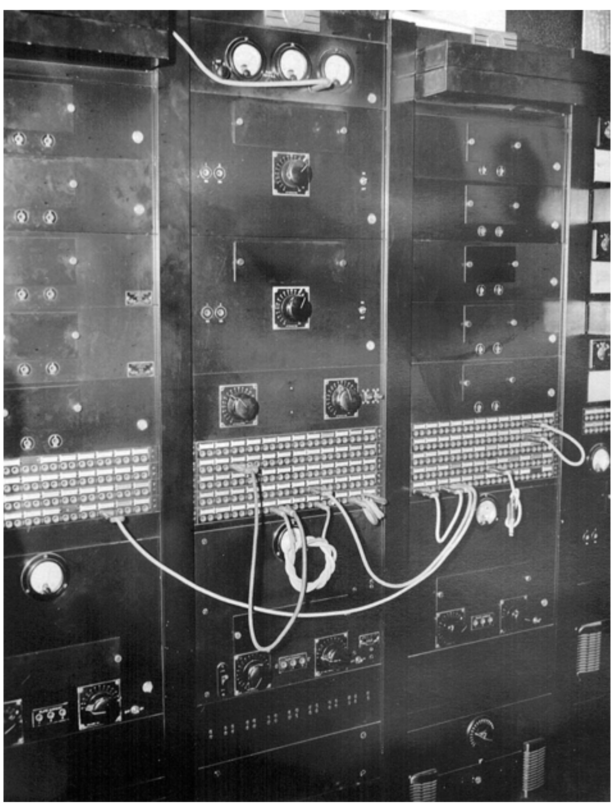
KYA is California's 30th oldest continoully braodcasting
radio station, and San Francisco's 2nd.

Carl Christensen's 2-page timeline of KYA evolution.

New KYA transmitter building and tower at Candlestick Hill in 1937.

KYA generator in the basement, 1937.

The console in KYA Studio B at the Hearst Building.



The speech rack at KYA.

The console in KYA Studio A.

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Mirror Screw Mechanical Television Project

By Richard Watts


Fig. 1: A mirror screw is a stack of thin narrow metal blades or slats that have been polished on their edge to a mirror finish and mounted on a shaft. Source: Peter Yanczer

The annual meeting for early television enthusiasts was hosted on May 27th by Gerhard Bauer. At the meet there were several rare sets, all operational. Gerhard presented an update of his early television website project where he showed a prototype that included the display of early television devices and of media clips demonstrating the quality and type of content of the era. The talks included two from John Staples, the first on the CBS/GE Chromacorder System, and the second was an in depth presentation of the evolution of the NTSC Color TV Standard. John also demonstrated his Iconoscope camera and his mechanical Nipkow disc televisor. And at the event, I demonstrated my mirror screw mechanical television project.

The Mirror Screw

In the 1920s and early 1930s there was much experimentation with different approaches to building mechanical televisions. The most successful were the devices manufactured by John Logie Baird in England. His devices typically used a Nipkow disk, a metal disk with holes arranged in a spiral that formed the lines of an image when the disk was spun. His devices were adopted throughout the UK and were the basis for the BBC.

Other mechanical TV approaches included devices that utilized many mirror segments that, when spun, reflected video from a nearby modulated light source to produce an image. One of these is the mirror screw.

A mirror screw is a stack of thin narrow metal blades or slats mounted on a central shaft, their front edge polished to a mirror finish, and have been radially spaced equally around the shaft forming a cylinder and having a screw-like appearance. The more slats in the mirror, the higher the resolution of the resulting image. Mirror screws can have as few as 30 slats forming a low resolution 30-line image, up to 180 lines producing a very fine image. In the case of a 30 line mirror, the slats would be radially spaced 12 degrees apart (12° x 30 = 360°). The slats were typically of aluminum or stainless steel, the latter being preferable as it would not oxidize.

The mirror screw was driven by a motor. There was also a light source some distance in front of the spinning mirror screw. As the mirror spun, only a portion of the single slat facing the light source would reflect the light to the viewer at any instant. As the mirror rotates, the light paints across the slat forming a line of the image. When the mirror has turned enough so that slat no longer aligns the light source with the viewer, the next slat rotates into alignment reflecting the next line of the image. And so on.

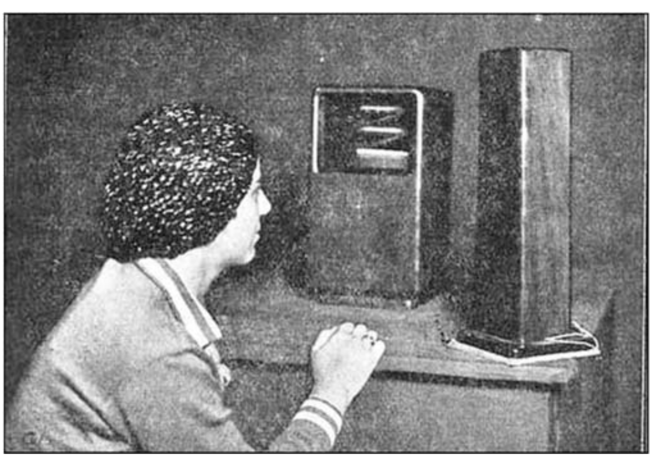


Fig. 2: A 30-line set made in French. Source: Peter Yanczer

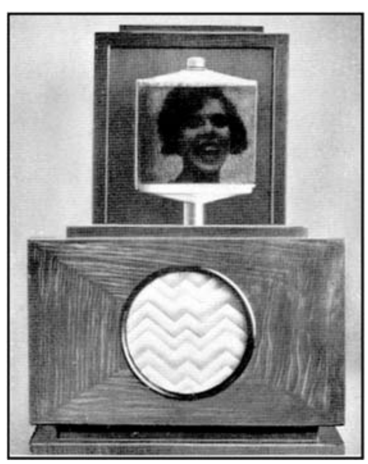


Fig 3: Replica of TeKaDe set made by Peter Yanczer


Fig. 4: 90-line set. Source: Peter Yanczer

The speed of motor rotation has to be precise as it directly controls the frame rate (number of frames per second) of the image. This frame rate has to exactly match the frame rate of the received signal being projected by the light source. Further, there needs to be a mechanism for synchronizing the spinning mirror with the beginning of the each frame so the image will align properly on the mirror. If the motor and the image will align properly on the mirror. If the motor and the transmitter were on the same power grid, then the power grid could be used to synchronize the receiver motor to the transmitter. When this was impractical, then other means of synchronization were used. For example, a synchronous motor, rotating at a constant speed, was mounted on a bracket that could be adjusted by the user to change its rotational position relative to that of the mirror. This advances or retards the beginning of the image until the image is properly aligned. An example of such a control is the sliding knob on the lower front face of the set in figure 4.

The mirror screw offers advantages over other mechanical TV approaches. First, it produces a relatively large, high quality image this size of the mirror. Second, there is no overlap between scan lines that were often encountered in Nipkow disk devices; this provides more brightness and image clarity.

Mirror screws also can be viewed over a wide viewing angle (about 120 degrees). As the viewer moves his or her position moves around the mirror, the reflection from the light source will be viewed from the previous or subsequent mirror. The viewer will see that the entire image the shifted up or down one scan line (a minor issue). For example, figure 5 diagrams seven viewing angles, each aligning with a different slat.

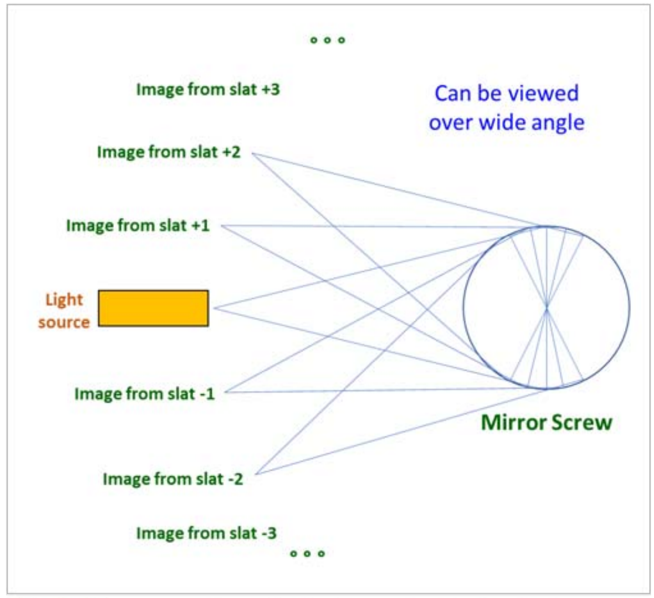


Fig. 5: Mirror screw has wide viewing angle. As the viewing position moves around the mirror, the reflection from the light source will be viewed on the previous or subsequent mirror.

Mirror Screw History

There is very little historical information available about the mirror screw and devices. The primary source for this summary is from Peter Yanczer's old website.

Mirror screw apparatus was first patented by D. B. Garner from Los Angeles, CA in 1928 (see figure 6 to the right). As shown in Patent Fig. 4, the mirror surface of a slat is typically flat; but in it is clear that D. B. Garner was proposing concave, convex, and other slat designs (see Patent Fig 6 through Fig 9).

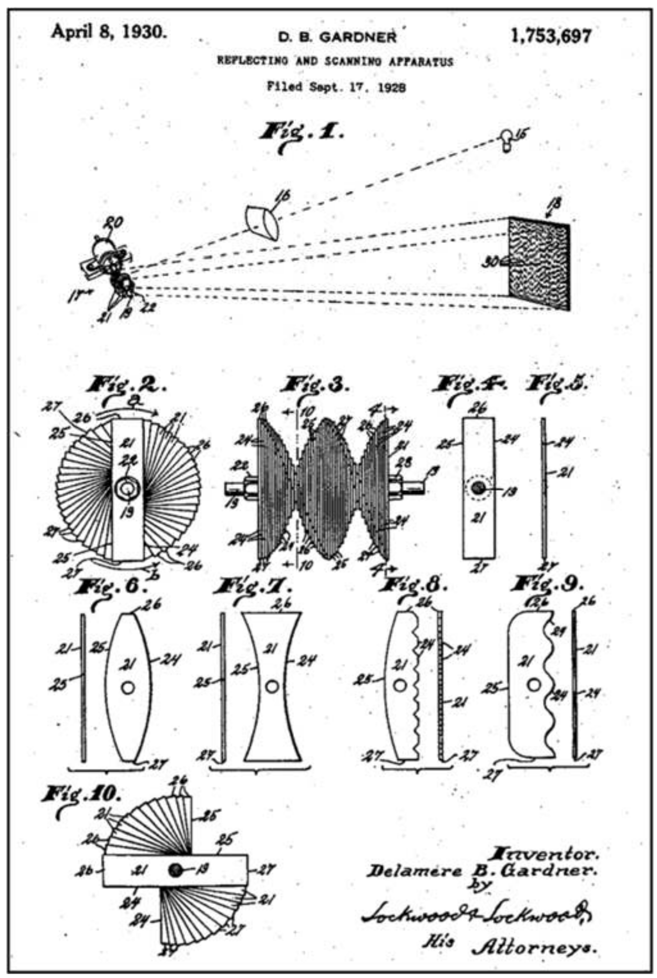


Fig. 6: D.B Gardner 1928 patent for Reflecting and Scanning Apparatus.

Hungarian engineer, Franz Von Okolicsanyi had a similar idea for a helical mirror device but had not patented it; However, he did patent an improved design in 1931. In 1930, TeKaDe company of Nurnberg Germany, with Okalicsanyi as head of development, worked to replace their Nipkow disks and mirror drums with mirror screw technology. By 1933, mirror screw sets achieved 180 line resolution. TeKaDe was also experimenting with all electronic approaches to television, just as RCA was doing; By 1937, TeKaDe had transitioned from mechanical mirror screw technology to electronic CRTs.

Mirror screw sets also manufactured in France (figure 2 is an example). Mirror screw technology not pursued in the USA primarily due to RCA's dominance and its intention to focus entirely on electronic approaches.

Fig. 7: The mirror screw after polishing and before the alignment of the slats. Perhaps this is the first mirror screw selfie.

The Mirror Screw Project

There have been several mirror screw projects documented in recent years, Most done by members of the Narrow Band Television Association (NBTV) located in the UK. These projects were documented in the online NBTV forum; also on the EarlyTelevision.org, and Peter Yanczer websites.

I decided to make a 60-line mirror screw as I felt that would provide satisfactory image resolution and be within my ability to construct it. The more lines (hence more slats) a mirror screw has, the more difficult the construction and the tighter are alignment tolerances.

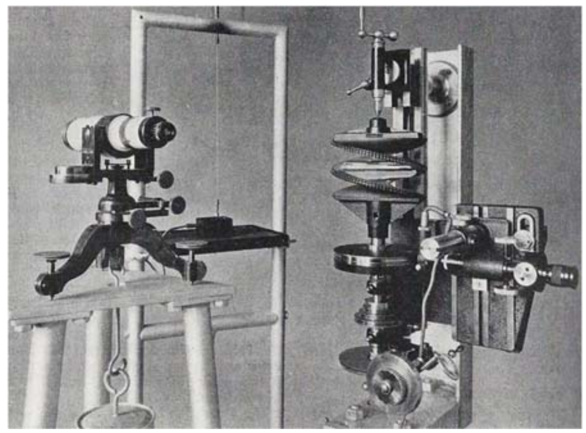


Fig. 8: An alignment jig circa 1935. The assembly upon which the mirror screw is mounted has vernier dials that provide precise rotation of the screw. It appears the scope position is fixed and set to view the reflection in the mirror screw of the wire mounted on the adjacent frame. From the black marks at the top of the frame, it appears that the wire was energized to glow and provide a precision light source. Source: Television To-Day, vol 2, pg 550.

I wanted it to be large enough to be viewable by a group, but not so large as to create excessive mechanical stress on the shaft and bearings. Also the larger the mirror, the farther the viewer has to be from the mirror (more on that later). So I felt that a 6" wide mirror would be a good compromise. The mirror slats are 14 gauge stainless steel which is 0.075 inches thick. This provides a mirror height of 4.5 inches giving an aspect ratio of 4:3.

I had the slats cut out be an online source that used a waterjet. I mounted the slats on a 0.5" diameter shaft and had a machine shop grind it flat. Then I was able to polish the mirror using progressively finer grits of sandpaper and diamond polishes. The final pass was with a 1 micron diamond polish. See figure 7.

Slats of a 60-line mirror are aligned 6 degrees apart (360°/60 = 6°). Precision in alignment is critical. An error of 0.1 degree (i.e. 6 minutes of arc) causes 0.1" offset in the start of the scan line from the edge. An example of a 1930s alignment jig is shown in figure 8. Figure 9 shows the alignment jig I built using a rotary stage.

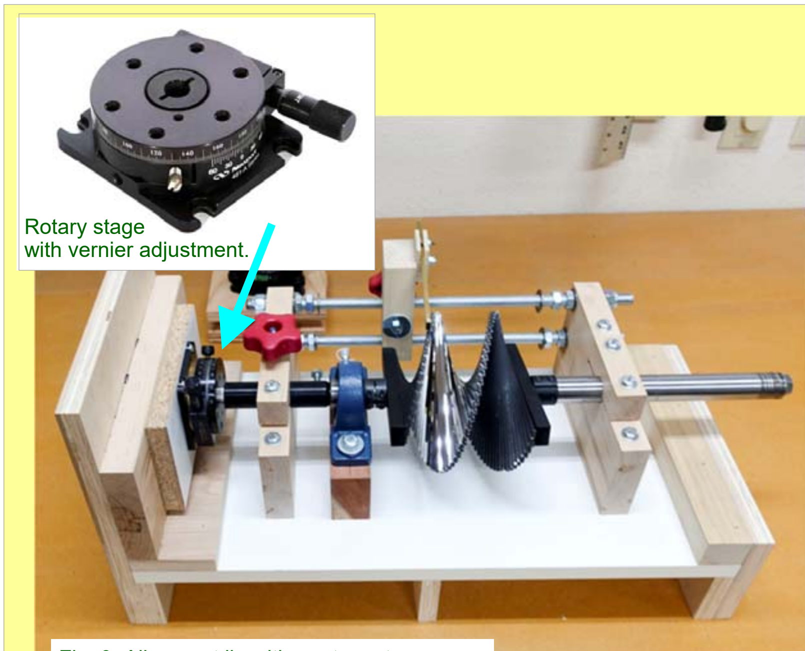
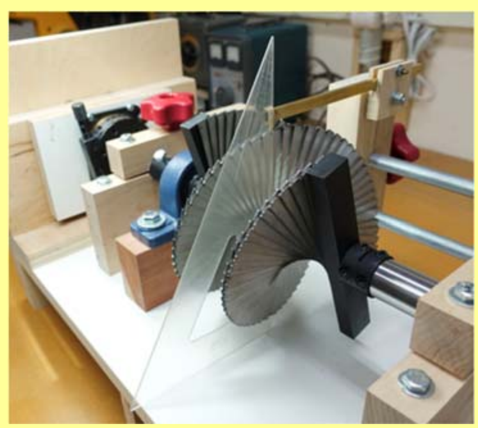


Fig. 9: Alignment jig with a rotary stage.



Alignment procedure: Beginning at one end, slats are aligned one at a time in sequence. The rotary stage is set to the appropriate degrees of rotation for the specific slat and the jig is locked to prevent rotation. The brass stop is inserted into a slot on the side of the prior slat preventing it from moving. The slat is then aligned 90° to the flat surface using a triangle. Once the slat is aligned, the mirror is rotated 6° and locked to adjust the next slat.

During the era of mechanical TV experimentation and manufacture, several video formats (frame rates and scan lines of resolution) were used. These formats changed to the conform to the design of various device manufacturers. The formats also evolved to support greater resolution as devices were made with increased scan lines. None of these old formats are compatible with modern video standards. There are a couple options for providing video in obsolete formats. One can generate their own video content as John Staples did for his Nipkow disk set as described in his article in CHRS Journal Vol. 35, No. 2—Fall/Winter 2016; or one can use a video converter capable of changing the frame rate and resolution of modern video formats to the old formats which is what I did.

Fig. 10: Aurora World Converter (WC01) video standards converter.

I acquired an Aurora World Convert (WC01) from Darryl Hock (figure 10). This is the swiss army knife for video conversion and many obsolete formats are supported. Video conversion is a complex and difficult problem, the capabilities of this converter are impressive and Darryl's design is nothing short of magic. This converter offers a couple of 60-line formats and I chose a Jenkins format that has 60-lines at 20 frames per second (60/20p). I opted to get the LED driver option as well.

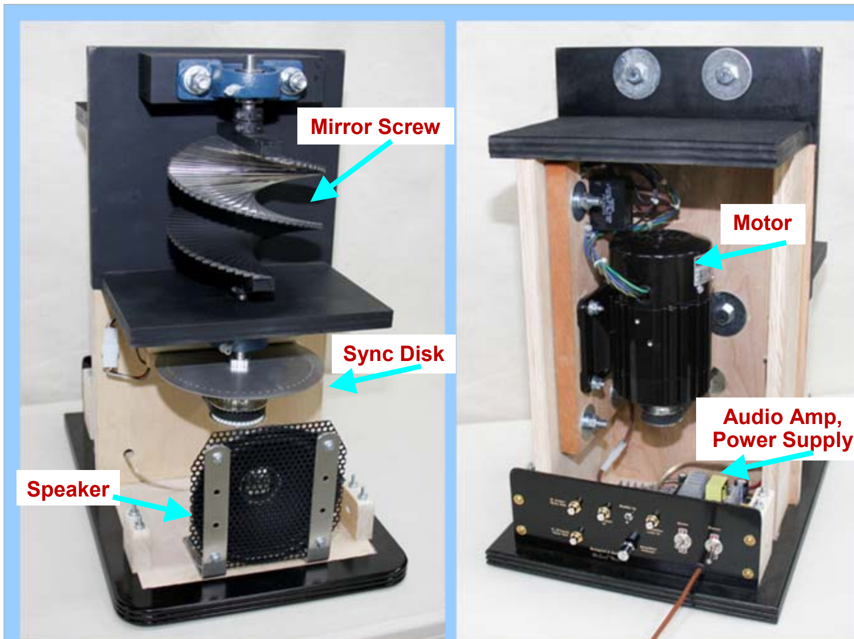


Fig. 11: Mirror screw TV assembly front and rear views.

The 60/20p format requires that the mirror spin at 1200rpm (20 frames/sec x 60 sec/min). I had an 1800 rpm synchronous motor, so I used a timing belt and gears to reduce from 1800rpm to 1200 rpm.

I built a frame on which the mirror screw, motor and accessories are mounted (figure 11). The accessories include a small audio amplifier, speaker, and 12 VDC power supply to power the amplifier. The acrylic back panel has a power switch, motor on/off switch, connectors and volume control for audio, and connectors for horizontal and vertical sync.

To generate sync pulses, I added a sync disk mounted on the shaft with holes spaced every 6 degrees radially to coincide with the position of each mirror slat. I made an infrared LED and phototransistor sensor to detect both horizontal and vertical 3.3v DC sync pulses from the rotating holes. My intention was to use these sync pulses to trigger the frame and line output of the converter. In practice, even though the holes were created by the CNC waterjet process from a CAD drawing, the holes were still not located accurately enough to produce precise sync pulses. Instead I found that, since the motor rpm was very precise, I could produce a synchronized image simply by adjusting the beginning of the frame on the Aurora Converter.

Since the Aurora converter supports RGB color, I decided to build a color light source even though it wasn't done in the 1930s (figure 12). The rule-of-thumb recommended by other builders is for the light source height to be at least 120% of mirror height. My light source is 6.5" tall which I deemed to be sufficiently tall compared to the 4.5" mirror height.


Fig. 12: RGB light source with 30 LEDs per color. The side of the light box has been removed to show the interior. The right view shows the array lit. The beam appears through the adjustable aperture.

I designed my light source to have 30 LEDs for each of the three colors (red, green, blue). To reduce the voltage requirement of the array, I divided the 30 LEDs of each color into 10 parallel strings of 3 LEDs. The current requirement of the array is compatible with the Aurora WC01 LED driver setting of 225ma. The beam is focused through semi-round rod lens that I cut from an acrylic rod. I made an aperture on the front of the light box to adjust the width of the beam.

Fig. 13: Test setup with mirror screw set on the left and light source on a small tripod to the right. The oscilloscope was there to assess sync pulses.

To have the image horizontally fill the width of the mirror, there is a specific optimal distance separating the light source and the viewer from the mirror screw. The distance depends on the mirror width and the rotation required to sweep one scan line, which for a 60-line mirror is 6°. For my mirror, the geometry calculation to sweep 6° across the 6-inch mirror width indicates the optimum distance is 57". If the light source or viewer is closer than that, multiple horizontal images will appear.

The Jenkins video format produced by the Aurora Converter has an aspect ratio of 6:5. Since the mirror has a 4:3 aspect ratio, the viewer will see slim partially repeated image on left and right mirror edges.

Figure 13 shows the mirror screw setup for initial testing.

I also constructed a removeable cabinet from mahogany shown in figure 14. The cabinet slides down over the top of the mirror screw assembly and attaches with four screws at the bottom.

Fig. 14: Cabinet made from mahogany.

Results

Generally the mirror screw worked well, however, there are two issues:

1. My light source has proven to be too short. It is necessary that the viewer be about 10' from the mirror to view the entire image. If the viewer is closer than that, then image projected by my short light source cannot be fully seen without the view nodding their head up and down. To correct the problem, I am building a taller 48-LED RGB array fitting in an 11" light box; Each color will have 12 parallel strings of 4 LEDs each. Because of the limitations of the short light source, I haven't yet been able to photograph the projected image satisfactorily.
2. Even though much care was done during alignment, there are some mirror slats showing minor deviation from the ideal 6° offset. The error is a just a few minutes of arc or less but is still noticeable. To provide a more precise alignment method, I acquired a CNC driven rotary table that I will retrofit into the alignment jig. Then I will realign the mirror.

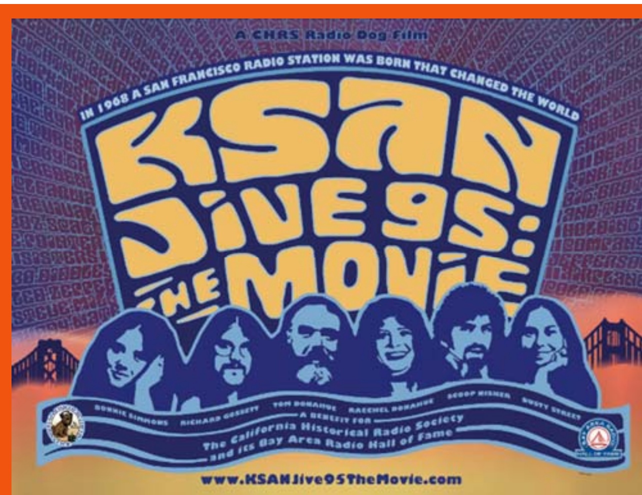
I knew little about mirror screws when I first considered this project. I found that with sufficient planning, research, and forethought, this project is achievable. My primary goal in tackling this project was to learn about something that I found intriguing — and I did learn a lot. In that regard, this project was a success. ◊

KSAN Jive 95: The Movie

Our CHRS Radio Dog Production, **"KSAN Jive 95: The Movie"** continues in production. But making a feature length documentary is costly. We are seeking to raise $150,000 to produce this film. The KSAN Jive 95 story is perfect for CHRS to tell and immortalize in film as it is an important part of our mission to preserve and present local radio history. KSAN, during the period 1968-1980, was pivotal in the development of our popular culture. This film will raise awareness and refresh remembrances of a time when a radio station could create change and really make a difference in so many ways.

Part of our recent grant from the Rex Foundation was earmarked toward the KSAN Movie project. We commissioned famous poster artist Wes Wilson for a movie poster. Wes and his daughter Shirryl Bayless collaborated to create this outstanding poster.

Now it's your turn to help. Please visit www.ksanjive95themovie.com and see how you can get great perks for donating to this project and help to preserve the KSAN Jive 95 legacy.

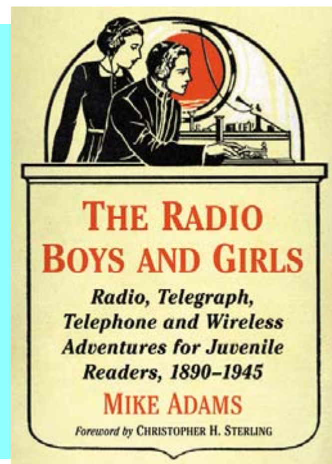


CHRS Publications

The Radio Boys And Girls—Radio, Telegraph, Telephone and Wireless Adventures for Juvenile Readers 1890-1945 is the latest book by Mike Adams, It captures the genre of series fiction about wireless and radio was a popular in young adult literature at the turn of the 20th century and a form of early social media. Before television and the Internet, books about plucky youths braving danger and adventure with the help of wireless communication brought young people together. They gathered in basements to build crystal. They built transmitters and talked to each other across neighborhoods, cities and states. By 1920, there was music on the airwaves and boys and girls tuned in on homemade radios, inspired by their favorite stories.

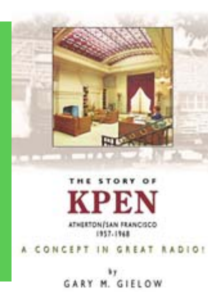
This book covers more than 50 volumes of wireless and radio themed fiction, offering a unique perspective on the world presented to young readers of the day. The values, attitudes, culture and technology of a century ago are discussed, many of them still debated today, including immigration, gun violence, race, bullying and economic inequality.

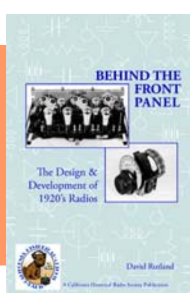
Available now at Amazon.com



The Story of KPEN: A Concept in Great Radio! CHRS member and Broadcast Legend Gary Gielow has written a new book chronicling the tales of two young men from Stanford, he and James Gabbert, who brought Stereo and new ideas to the FM radio band in the late 1950s and 1960s. This book is the definitive history of KPEN 101.3 FM, the 2015 BARHOF Legendary Station. 100% of the proceeds benefit CHRS.

Available in the Museum Store or on the website.

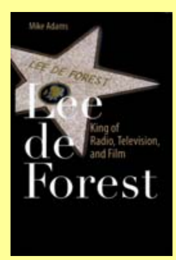




Behind the Front Panel: The Design and Development of 1920's Radio by David Rutland has been re mastered by Richard Watts for CHRS. With emphasis on radio technology, Rutland describes the development of 1920s tubes and radio circuitry designs by De Forest, Marconi, and other inventors and manufacturers. A classic!

Buy at Amazon.com

Also available in the museum store



Lee de Forest

Bay Area Radio

Will Rayment

KSAN Live Jive CD

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Radio Day Moments

Gilles Vrignaud
Volunteer of the Year