A PIONEER

By PAUL G. WATSON
Commander, USNR (Ret.)

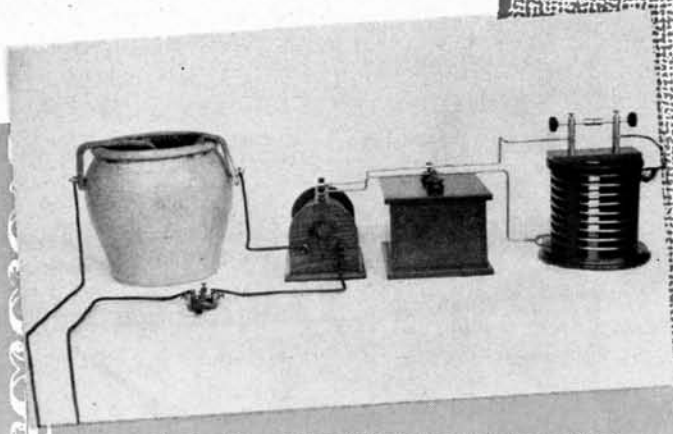
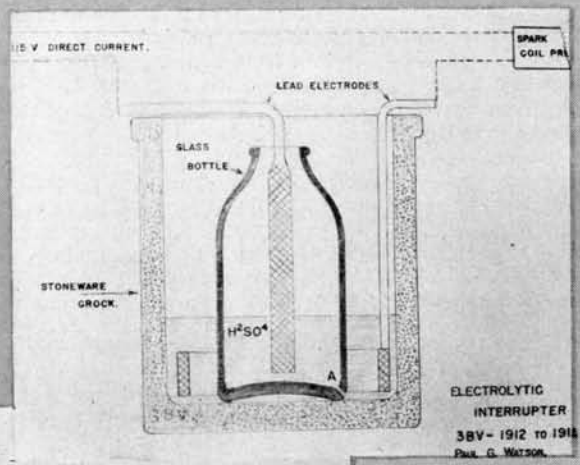


Fig. 1. The original 3BV spark transmitter of 1912, operated from a 115 volt d.c. power line. From the left to right, electrolytic interrupter used to chop d.c. to the coil; spark coil; condenser; and the "helix" with the spark gap located on the top.



↑ Fig. 2. Cross section of electrolytic interrupter. Vaporizing or exploding of acid in hole "A" produced the break in the current.

←Fig. 3. Original elements of 1912 interrupter assembled outside of the crock.

↓ Fig. 4. 1912 cabinet receiver with the galena detector.

1919

Radio amateur, 1910-1933; operator, 1918-1922; electrical engineer, 1923; chief radio inspector U.S. Shipping Board, 1924; radio supervisor (Savannah), 1924-25; U.S. radio inspector (Savannah), 1925-26; radio compass engineer (RCA), 1926; later with private industry and the U.S. Navy.

1954

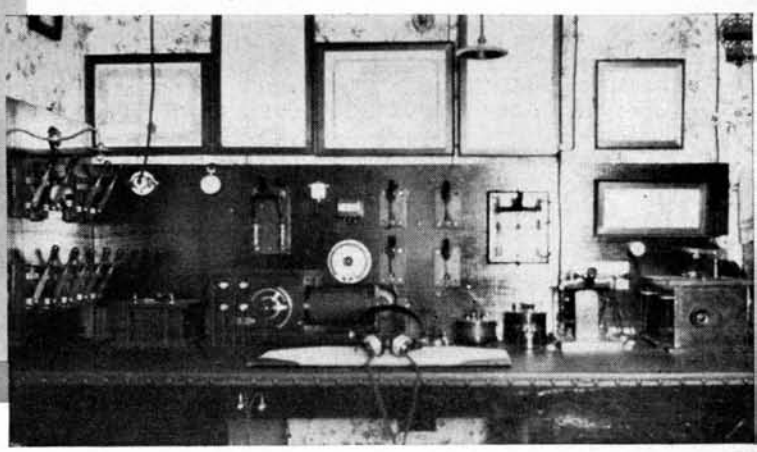
WHAT was amateur radio like in the early days? What was the equipment like, and what would it do? These are questions put to those of us who lived the early days of radio and in the following pages the writer will give some of his own experiences, beginning in 1910 with just a receiver, a transmitter in 1912, then on through the various stages of development to a home-made superheterodyne receiver and a c.w. transmitter in 1927.

Amateurs got their information from scientific journals and magazines, mostly in picture form with an occasional diagram. There were no strictly "wireless" magazines at the time, although several of the "scientific" magazines ran special departments as the subject of "wireless" grew. From these sources you got all possible information and then made all of your own apparatus except, possibly, the spark coil of the transmitter.

The writer's start in 1910 was made with a single slide tuning coil, electrolytic detector, fixed condensers, and an old telephone receiver. The antenna was large, four wires 90-feet long and 60-feet high. A diagram (Fig. 11) is shown to give an idea as to functioning of this receiver, and its method of tuning.

A detailed description of the receiver elements will help to clarify the picture as to what was known about tuning circuits. The inductance was a coil of about 300 turns of #24 cotton-covered magnet wire on a 3-inch wooden cylinder, well impregnated with orange shellac to hold the coil

Fig. 5. The loose coupler, Crystaoli detector, and Murdock condenser as set up with old receiver (right) in 1916. The transmitter is housed in the cabinet located under table.



AMATEUR STATION

A trip to "nostalgia" for the old timer and a glimpse into the past for today's ham. Amateur radio has come a long way!

in place. A bare strip was carefully sanded down the top center of this coil, and a sliding contact arranged on a square bar to contact the individual turns of the coil and provide its inductance variation as one of the tuning elements.

The three condensers and switch shown in the center section of the diagram, with the inductance described, complete the tuning circuit. This capacity unit consisted of a four-point switch and three fixed condensers of wax paper and tinfoil. The first condenser had five leaves, the second ten, and the third twenty leaves, all in a wooden box with the switch on top. Now we come to what would today be called balancing the *"L"* and *"C"* values of the circuit. On the first contact of the switch no capacity was across the coil. When the slider tuned to the end of the coil (maximum number of turns), the switch was moved to the second point and the first condenser cut in. Its capacity had been so arranged that it re-established resonance at the same frequency with the slider near the center of the coil, and so with the other two progressively larger condensers, as the slider neared its maximum, cutting in the next larger condenser would bring it back to center position for best tuning adjustment.

The electrolytic detector was, at the time, considered the best and most reliable means of rectifying signals, with the possible exception of de Forest's "Audion" tube. The electrolytic detector used here was composed of a microscopic platinum wire, silver plated, known as "Wollaston wire," the tip end of which was immersed in a small cup of dilute nitric acid. When the cup and the wire were connected in the radio circuit, slight gas polarization collected on the tip of the wire, giving unilateral conductivity and rectification of signals which became audible in the headphones.

Today, all this sounds very crude, but it was a reasonably close copy of *United Wireless'* Type "D" receiver, the best of its kind in the commercial field at the time, and differed only as to the type detector and condenser, and the fact that it had only one slide instead of two.

So we listened on the air for a year or so with this gear, when the urge to "get on the air" hit with a bang. Early in

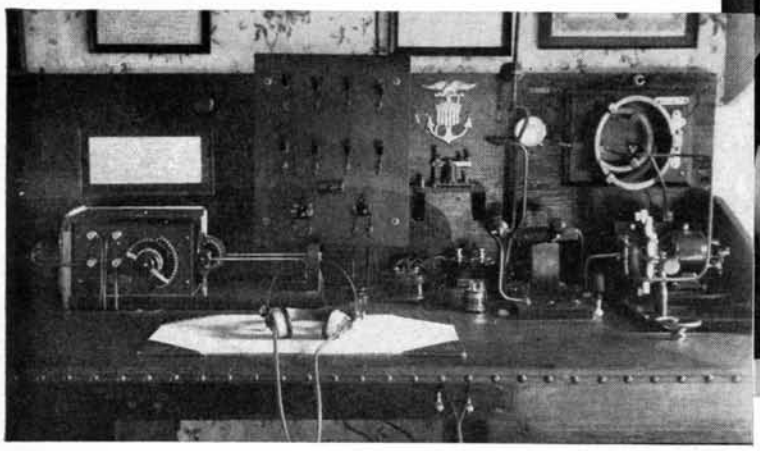


Fig. 6. The 1919 station with the inductively-coupled, rotary spark transmitter and the loose-coupled receiver with its Crystaoli detector. See Fig. 7 for photo of the transmitter parts.

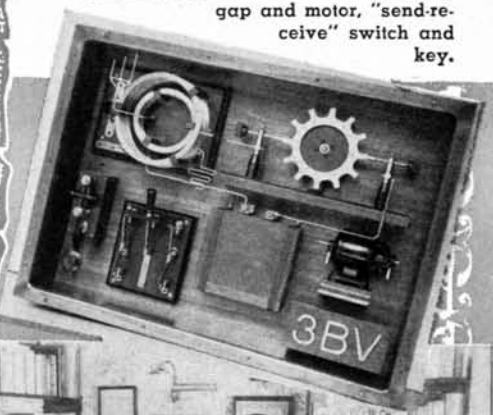


Fig. 7. The 1919 transmitter in display cabinet, oscillation transformer, rotary gap and motor, "send-receive" switch and key.

Fig. 8. Station in June, 1922—all home-made gear. Left to right, honeycomb coil receiver, variometer receiver in rear center, detector panel with "Audotron" tube at right, two-stage audio amplifier in corner, and the spark on the floor at the end of the table.

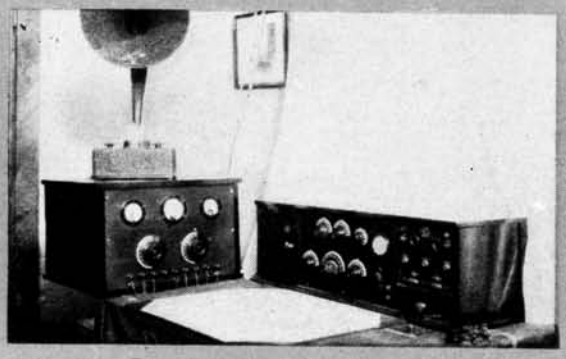
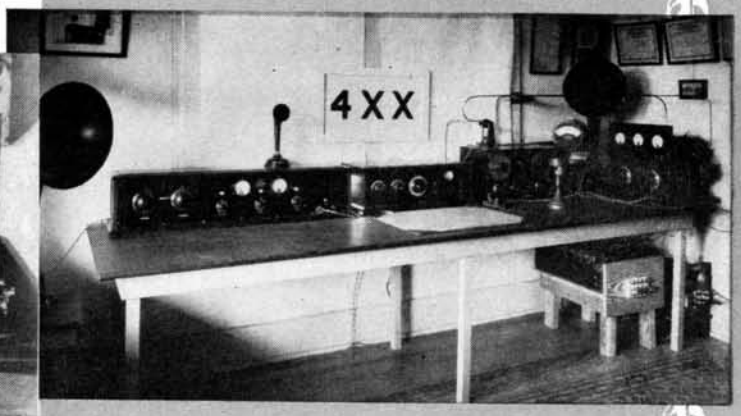


Fig. 9. 4EO, 4ZD, 4XX 100 watt transmitter with honeycomb coil receiver at Savannah, Georgia in 1923.

Fig. 10. 4XX station in Savannah, Ga. in 1927. The 100 watt transmitter is at right, then CM 294 Navy receiver, s.w. regenerative receiver under callsign, and (left) the 20 to 800 meter, 10-tube superhet.



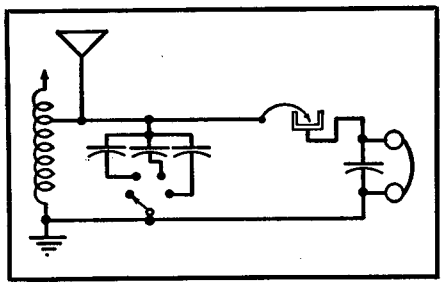


Fig. 11. Single slide tuner circuit as used in the author's 1910 receiver. The early version used an electrolytic detector which was later replaced by a galena crystal.

1912 a one inch "Bull Dog" spark coil was purchased and, along with a fellow experimenter, we set out to build a "sending set." This first transmitter was very simple, an old *Western Union* telegraph key was connected between eight dry cells and the primary of the coil, a spark gap was connected across the secondary, one side of the gap was grounded, and the other side connected to the antenna. After fixing up the antenna insulation several times, signals were heard a quarter mile away (in dry weather). The entire antenna insulation consisted of unglazed porcelain tubes and cleats used in house wiring, and the station was put on an "all weather" basis by boiling all the porcelains in red sealing wax and paraffin.

Now we were on the air, with a little squeaky spark note generated by the coil vibrator. We listened to a lot of the "big boys" growl and gurgle with notes resembling everything from a bad power leak to a rusty gate hinge, but they had *"power"* to get through. (Sounds like something I heard on 80-meter phone this past week.)

We were all "power" minded and when an article came to hand showing a de Forest station with plate glass condensers and a "helix" to tune with, that was for us, as it was supposed to double your range.

A condenser was made by cleaning off several glass photo plates, shellacking tinfoil on each side an inch from the edge, and when the stack was completed tying the whole bundle with cotton tape and immersing it in mineral oil, then placing the whole unit in a box.

The "helix" previously mentioned was the tuning inductance, 10 turns of #6 bare copper wire spaced ¾ inch between turns on an 8-inch diameter wood column support. It was used as a common inductance in both the antenna and the spark circuit, tuning being accomplished by moving either the spark circuit clip, or that of the antenna, or both if needed after the proper number of condenser plates had been determined.

What an improvement this made. My friend and I could now tune out each other's signal by moving our sliders forty turns either side of the maximum point.

In 1912, alternating current was available in very few places and certainly not in the little town of West Chester, Pa. where all this "scientific" development was taking place. We wanted "power" and we had power available in the form of 115-volt direct current for house lighting. We already had tuned transmitters so during the summer of 1912 an electrolytic interrupter was made to work the transmitter directly from the 115-volt d.c. line. The only change necessary in the apparatus was the bridging out of the mechanical vibrator on the spark coil and the connection of the key and the coil primary through the electrolytic interrupter to the power line.

Fortunately all of the original apparatus of this transmitter has survived the 42-year gap since it was first assembled and is shown in Fig. 1 wired as it was in 1912 for use on the 115-volt d.c. line. The only thing missing from the picture is the two clips in the helix for antenna and ground connection.

In 1912 we did not have TVI, but if anybody except ourselves thought our connecting a transmitter, drawing 10 amperes, to the power lines was a good idea they did not say so. In fact the local paper ran an editorial on how we had ruined Edison's wonderful invention. People, not scientifically minded, who lived within a block of our home objected to their lights blinking. When the power company checked a house on our street they found the voltage dropped from 115 to 90 when we opened up. In our own home, in addition to the blinking lights, there was the problem of odor from the decomposition of sulphuric acid, and on one occasion a broken crock dumped a gallon of acid solution on my bedroom floor at 2 a.m. This gradually worked through the floor and dripped on the kitchen range below. My mother did not like the beautiful orange color of her range the next morning.

What was this devilish device that caused so much trouble? It is shown at the left of Fig. 1 as it was used in 1912. Fig. 2 is a cross-section view, and Fig. 3 a picture of the actual elements used in 1912 to pulsate the 115-volt direct current to the coil. It consisted of a stoneware crock of about two gallons capacity, filled to a depth of 4 inches with a sulphuric acid solution. A quart milk bottle was drilled with a file end at point "A" (Fig. 2) to about 1/16th inch diameter and was then placed in the acid in the crock. A lead pipe electrode contacted the acid inside the bottle and another electrode was placed in the acid in the crock. By this arrangement, the only electrical connection between the two electrodes was through the small column of acid in hole "A" of the bottle. When the 10 ampere current passed through this column of acid it promptly vaporized (exploded is a better word) and thereby opened the circuit. The acid then fell together, closed the circuit, and the cycle repeated itself as long as current flowed.

In spite of all the difficulties, we got going with the interrupter setting in a lead-lined box and by operating only in daylight or early morning hours. Just

(*Continued on page* 89)

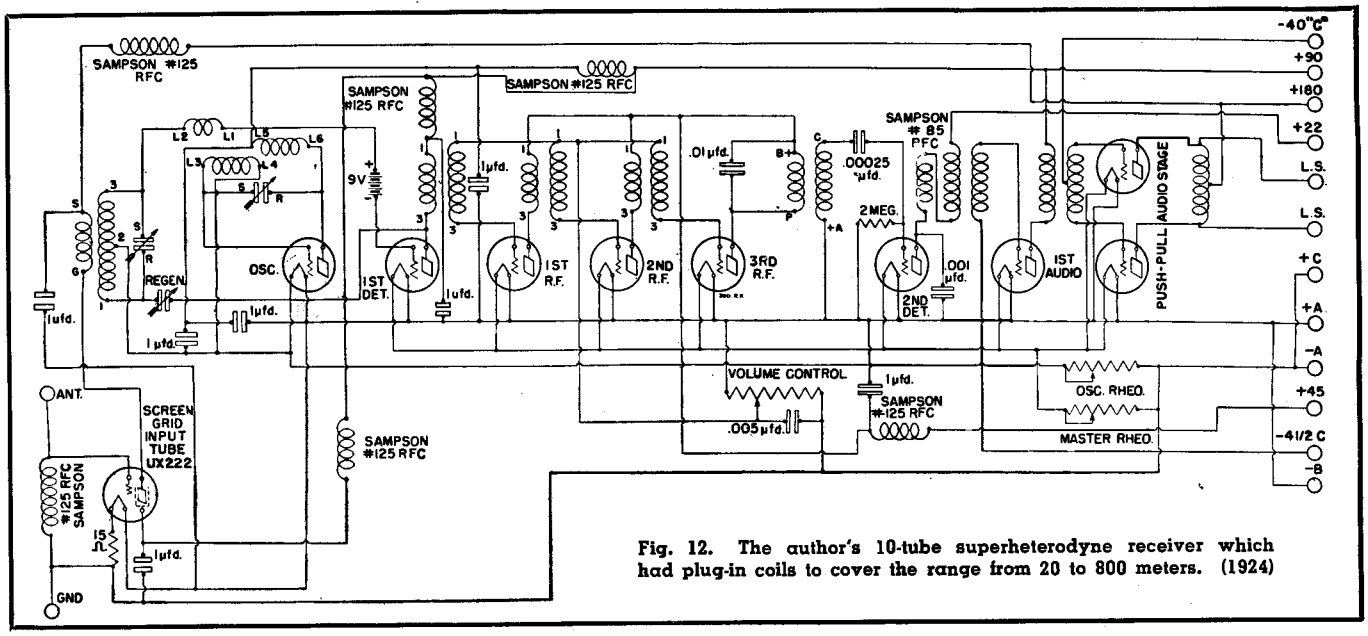


Fig. 12. The author's 10-tube superheterodyne receiver which had plug-in coils to cover the range from 20 to 800 meters. (1924)

Pioneer Amateur Station

(*Continued from page* 34)

what this spark sounded like on the air is hard to describe. It was generated by gas explosion and fluid flow return, and it sounded just like that. The nearest thing today is a loose wire in a pole transformer. It defies any other comparison. But we were on the air with "power."

The summer of 1912 found us in Philadelphia one day listening to a receiver with a galena (lead sulphite) crystal detector, and we got a piece to try. It worked better than the old electrolytic detector, but "setting" the "catwhisker" on a sensitive spot was a job until we learned to judge the degree of sensitivity from the pickup of a buzzer spark.

In the fall of 1912, with the messy acid of the electrolytic detector removed from the picture, the receiver was built into a cabinet. The detector and condenser switch was placed on the top and the slider operated by pulling out a knob on the end of the cabinet. This cabinet receiver survived the years, and is shown in Fig. 4. The circuit is identical with that shown in Fig. 1 with the galena crystal substituted for the electrolytic detector.

A natural question at this point is, what distance did this equipment cover? The battery-operated coil first used was of course local, not over 10 miles range, and when the power line was connected the distance was extended to occasional contacts up to 150 miles. The receiver brought in many stations up and down the coast from Boston to Key West, and many inland stations of the day. Its range depended on atmospheric conditions, as is the case with today's receivers. At night, stations all around the Great Lakes were clearly heard in West Chester.

Another question often asked: "What frequency (wavelength) did you use?" The most accurate answer is "Don't know." The only thing we had to go by was the publication, from time to time, of technical articles stating that a coil and condenser of given dimensions would give you 200 meters or 300, as the case might be. No such thing as a wavemeter (frequency meter) or standard frequency signal existed outside of government bureaus and a few of the larger laboratories. With these given coils (helix) and condensers, all an amateur could do to tune his transmitter was to insert a flashlight bulb in the antenna lead, and keep moving clips on the helix until the bulb was lighted to maximum brilliancy. That, in the early days, became your working frequency. Naturally much interference with commercial services and the Navy resulted.

Much was written in the early 1920's when spark was ruled off the air about its broad tuning, and this referred to well constructed commercial transmitters as well as home-built jobs like ours. Within five miles of our direct-coupled spark, any reception below 500 meters was purely accidental.

In 1916 the author took the examination, got a license, and the call "3BV" was assigned. At the same time a "loose coupler" or receiving transformer was purchased, together with a *Murdock* .001 μfd. variable condenser, a *Turney* "Crystaoli" detector and a pair of *C. Brandes* "Navy" model headphones. Fig. 5 shows this new apparatus, our first factory-made gear, and the old receiver as set up at the time (1916). The new receiving apparatus was a marked improvement over the old single slide tuner, the individual tuning of the antenna and detector circuits nearly doubled the signal strength. Also the secondary of the loose coupler would slide out of the primary, sharpening the tuning. The *Murdock* variable condenser was shunted across the secondary of the loose coupler and gave the final touch to the close tuning of any station heard.

The really novel feature of this loose-coupled receiver was the "Crystaoli" detector. A galena crystal was mounted inside one end of the hub of a

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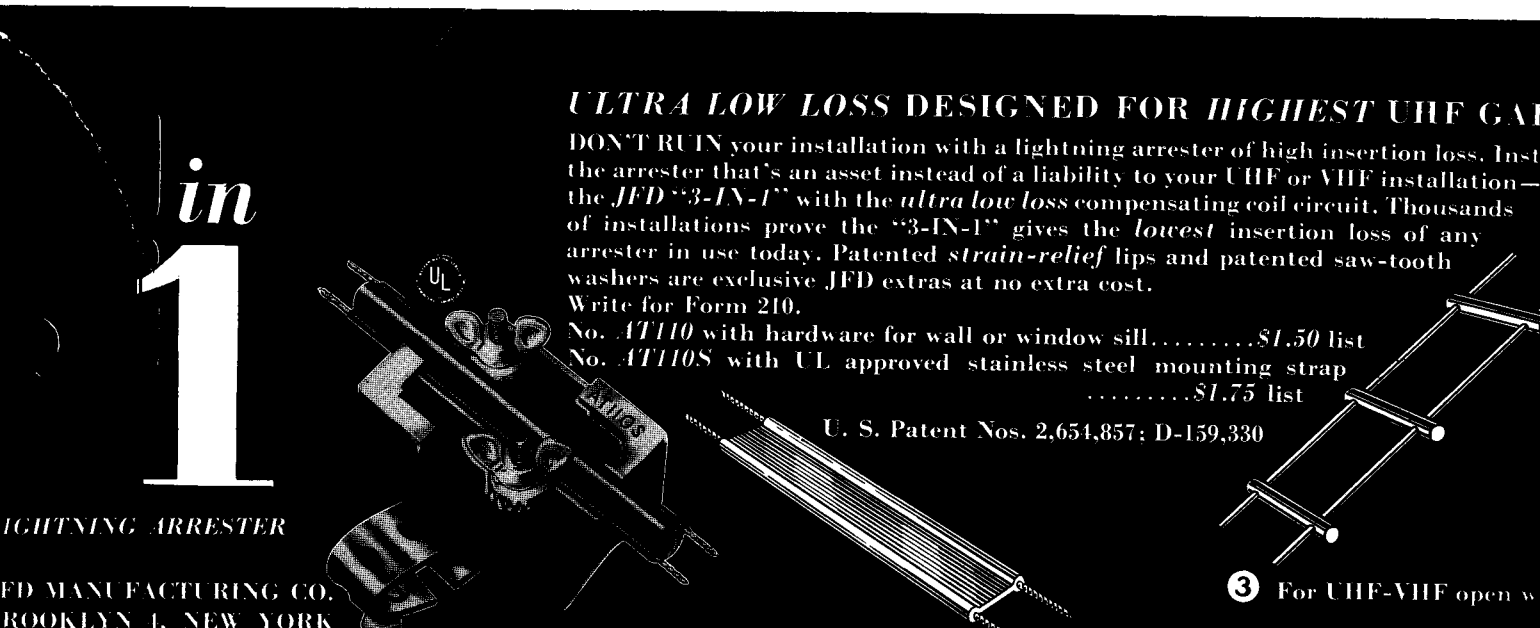

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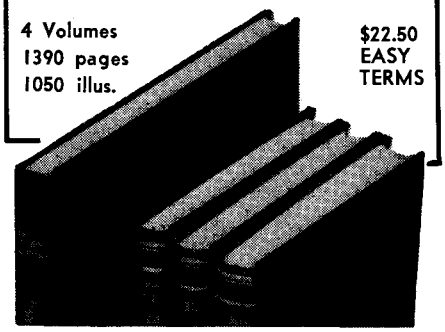

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small rubber disc, the opposite end of the hub being closed with a metal plug. The space between was partially filled with metal filings. This detector was "set" by slowly revolving the disc in its clips while the spark from a low frequency buzzer "cohered" the filings when a sensitive spot was found. This was by far the best crystal detector up to that time, and because of its shock-proof mounting, often stayed in adjustment for a week or more.

The station remained more or less like the photograph of Fig. 5 until closed down for World War I in 1917. The author went to sea in radio during that affair and in September 1919 opened up 3BV again. This station (Fig. 6) is the same loose-coupled, "Crystaoli" detector receiver used before the War. We had worked large sparks during the War and learned something about them. A *Murdock* oscillation transformer was purchased and a rotary spark gap made. However we still had d.c. power, so had to continue the use of the electrolytic interrupter and spark coil. A *Roller-Smith* hot-wire ammeter was added to measure antenna current.

Now we were really "in business" with over 3 amperes of antenna current, the transmitter inductively coupled to the antenna, and sharp as a razor on 200 meters. We got little benefit from the rotary spark gap as the modulation of the interrupter came through and the resultant note sounded like a buzz saw striking a nail in a log. Fig. 7 shows this transmitting apparatus, now mounted in a display case, in much better detail than the general station picture.

By June 1922 the station had been completely rebuilt as far as receivers go; the vacuum-tube detector and amplifier connected through switches to a honeycomb coil receiver for long-wave, and a variometer inductively-tuned receiver for amateur and broadcast, had replaced the old loose-coupled receiver. The same old spark had been placed on the floor at the end of the table. *All* of the apparatus shown in Fig. 8 was home-made and was described in detail in various early issues of RADIO NEWS in 1921 and 1922.

At the beginning of 1923, the real active days of the 3BV spark ended. Shortly after the picture (Fig. 8) was taken, a.c. power became available and a 1 kw. transformer was installed. With the rotary gap it produced a wonderful musical note on the air, but by this time the need for earning a living brought the writer to Savannah, Ga. as radio supervisor of the U. S. Shipping Board. After a year or so, the YL became the OW (we were plain-spoken in those days), and we started up in Savannah as 4EO-4ZD-4XX.

The first Savannah station (Fig. 9) was on the air late in 1923, first as 4EO and then as 4ZD and combined with the 4XX commercial experimental station license. This station was a 100-watt Hartley oscillator c.w. transmitter on the new short-wave (high frequency) bands. Plate supply was 1200 volts d.c. from motor generators. The receiver was a honeycomb coil affair with one stage of r.f., and was written up in the July and October 1924 issues of RADIO NEWS. The transmitter was housed in the cabinet supporting the loudspeaker, the receiver in the center of the large cabinet with a Grebe detector, and two-stage audio amplifier in the right compartment.

The "X" license in those days was granted for serious experiments with short-wave (high frequency) transmissions. Generally, any wave below the 200 meter point was allowed, and most of the stations at the time gravitated to wavelengths between 75 and 110 meters. The basic reason for this selection was that available parts were not capable of withstanding the higher frequencies. Condensers, for example, of "good" quality, just burned up. We worked a lot of foreign countries and had many good U.S. contacts as well.

Late in 1924 found the family moving into their own house in Savannah where there was plenty of space for a radio room, so the station shown in Fig. 10 was set up.

The transmitter was a rebuilt version of the previously-mentioned 100-watt Hartley, remodeled to get down to 20 meters. With more room, better parts, and ventilation it worked much better. To describe the station, Fig. 10, let us start with the transmitter on the right end of the table, next comes an old Navy CM 294 receiver for low-frequency work, next a short-wave regenerative receiver, and on the left end of the table is the large panel of a 10-tube superheterodyne receiver made from a BCL failure of the early days. Plug-in coils gave a range from 20 to 800 meters, with one stage of r.f. ahead of the first detector. The circuit of this receiver is shown in Fig. 12. This receiver was the result of toying with the idea that Armstrong's superheterodyne would someday be the ultimate in all receiver fields. It cost a small fortune to develop this from a complete failure. Little or nothing had been published about what the big companies were doing with superhets, although it was a well-known fact that they were working on them. In this case results, then and now, have more than justified the time and money spent on this receiver.

In 1927 a move from Savannah to the North was necessitated by our getting involved in radio compass work through the superhet development. Most of the next few years were spent traveling, so that there was no more time for amateur radio. We had a try at manufacturing quartz crystals in the early days in Savannah, and got into the design of modern transmitters using crystal control in their oscillators. We had to face it, amateur radio was over for us.

What had been accomplished with all this expenditure of time and money? We were established in radio compass work as a result of the superhet, and magazine articles had paid for most of the things they described. What was

accomplished technically in the way of advancement can be partially measured by a comparison of Fig. 11 and Fig. 12 as far as receivers go. Transmitters advanced from plain open untuned sparks to excellent c.w. and phone units. Possibly the most important of all, as a group, amateurs proved that the band below 200 meters, assigned to them originally because it was believed of no value to commercial or military services, was in fact the most valuable band in the spectrum. -30-

PIONEER "BROADCAST"

By CHARLES G. COOKE
Life Member, V.W.O.A.

HERE is the story of what was probably the first instance of music being broadcast by wireless.

It was in the spring of 1906 and the "USS Illinois" to which I was attached as wireless operator had just returned with the Atlantic fleet from winter maneuvers in the Carribean to Hampton Roads, Virginia.

I was on wireless watch using an electrolytic detector when I heard a spark changing its pitch to play what was clearly the first line of "Home Sweet Home".

Amazed and curious, I began a round of visitations to the wireless offices of the other ships in the fleet.

Finally, I found on the "USS Missouri" an ingenious operator with an 80 volt d.c. generator feeding a large spark coil primary through a mercury-turbine interrupter driven by a small motor, the speed of which was governed by a sliding rheostat which had been calibrated C, D, E, F, G, A, B, and C.

Thus it was only necessary to push the rheostat slider to the desired note, wait for the speed to stabilize, and push down the key.

You should remember, however, that in those days there were no wireless traffic controls, no interference, and the sky was the limit on jabber.

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Type AN/AMQ-1. Used by weather stations. Unit is sent into air on balloon to transmit information on temperature, moisture, and barometric pressure to the ground. All New ..... $4.94 Ea.

304 TL TUBES

High Power Triode. Bulk Packed. All Checked. Special ..... $3.95 Ea.

Thousands! CRYSTALS Thousands!

FT-241 54th Harmonic Type. Fundamental Frequencies listed below in KC.

370	390	410	430	449	469	486	508
372	392	412	432	451	470	488	510
374	394	414	434	453	471	490	512
376	396	416	436	454	473	492	514
378	398	418	438	458	475	494	516
380	399	420	440	458	477	496	518
382	400	422	442	460	479	498	520
384	402	424	444	462	480	502	
386	404	426	445	464	482	504	
388	406	428	447	466	484	506	

Each Frequency ..... 6 For $1.00
500 KC. 1.25

SOUND POWER HANDSETS

Use these phones without any external or internal voltage supply. Two or more can be used with only 2 wires interconnecting them. Use for TV installation, house to house or house to garage.
All new ..... Per Pair $18.95

FIELD TELEPHONES

EE-8 Type, Uses 2 1½ V. Flashlight Batteries for Power. Transmits over wire up to 10 miles, with Magneto Ringer. In Leather Case. In excellent Condition ..... $32.50 Per Pair

HEAD SETS

High Impedance R-14 Phones 8000 Ohm. For all standard Radio Output Circuits.
All New ..... $2.50 Ea.

TRIPODS

Heavy Duty 4 Ft. Adjustable Leg Wood Tripod with 5½" Diameter. Brass Mounting, Plate and Screw.
All New ..... $4.95 Ea.

BC 375 TUNING UNITS

TU-26 (200-500 KC), TU-7 (4500-6200 KC), TU-8 (6200-7700 KC), TU-9 (7700-10000 KC), All with Vernier Dials, and Many useful parts.
All used ..... Low Priced @ $1.50 Ea.

POLE CLIMBERS AND BELTS

Telephone Type Climbers with Leather Leg Straps. Used, Excellent Cond. ..... Pair $2.95 Ea.
Safety Tool Belts, Leather, to use with pole climbers. Used, Excellent Cond. ..... $3.50 Ea.

SELSYN MOTORS

Type 5F Syncro Motors, used in pairs for remote tuning or remote position indicators. 115 V., 60 Cy. operation. Size 3¼" Diam. x 5¼" long.
Like New ..... $35.00 Pair

SPECIAL A.C. MOTORS

1/40 Horse Power Bodine Sync. Motor, 1800 R.P.M. Operates on 110 V., 60 Cy. Has 2 shafts and fan type flange mount. Uses 5 Mfd. Capacitor for starting. Used for Fan, or small Grinder, Buffer or Hobby work. All in excellent condition.
Price ..... Ea. $7.95
Capacitor ..... Ea. $1.00

MIDGET SELSYNS

AY6 type operates from 6-12 Volts 60 Cycle. Use as both transmitter and receiver. These compact little units draw almost no current and work fine for all remote position indicating applications. OD 2¼x2¼x2". Has spring return shaft. All New (Appr. wt. 1 lb.) ..... Each $1.95

ARMY AMMUNITION CANS

Type M-3 50 Cal. Cans 12" Long x 6" Wide x 7½" Deep.
Type M-1 Cans 16½" Long x 3½" Wide x 6½" Deep.
All aluminum with Leather Handle and Hinged Top with hasp. Use for all your small parts or tools. O.D. Color, clean them and buff or paint ..... Each $1.50

PROP PITCH MOTORS

For your Beam Antenna: 20 Volt to 32 Volt. A.C. or D.C. Motor: 1¼ RPM Gear.
All brand New. ½ H.P. as above. $16.95 Ea.

CRYSTALS

DC-34 and DC-35, ¾" Spacing

1690	2050	2280	2467	2711	2980		3540	3870	4050
1705	2075	2295	2478	2725	3000		3575	3885	4055
1720	2082	2300	2491	2732	3010		3655	3890	4065
1738	2090	2315	2500	2745	3023		3665	3895	4085
1746	2105	2326	2510	2764	3027.5		3695	3905	4090
1770	2106	2335	2514	2775	3055		3702.5	3920	4150
1790	2131	2340	2527	2776	3077.5		3705	3925	4175
1810	2155	2355	2540	2807	3085		3730	3935	4177.5
1830	2175	2360	2586	2816	3117		3765	3940	4210
1850	2195	2375	2587	2831	3149		3769	3950	4215
1870	2202	2390	2599	2851	3161		3770	3965	4240
1890	2215	2395	2605	2863	3190	3317	3775	3985	4305
1910	2220	2415	2625	2894	3201	3345	3790	3995	4325
1930	2235	2422	2643	2895	3227.5	3365	3792.5	4012.5	4345
1970	2240	2435	2665	2899	3270	3395	3807.5	4015	4380
1990	2255	2440	2670	2925	3279	3412	3825	4020	4440
2010	2258	2446	2685	2926	3297	3412.5	3830	4030	4745
2030	2275	2466	2710	2960	3311	3462	3855	4035	

PRICE 85¢ Ea. ..... 6 For $4.50,
SHIP BAND FREQUENCIES 2142, 2174, 2638, 2670 ..... $2.00 Ea.

12 VOLT DYNAMOTOR

PE-55 Power Pack. Complete New Unit with DM-19 Dynamotor, Filter and Relay Base. Continuous Ratings, 500 V. @ 200 MA output or intermittent 500 V. @ 400 MA. These are all NEW in original cases. $17.95 Ea.

RM-29 FIELD PHONES

Remote control unit for Transmitter or Receiver which can be used in pairs over wire with internal 4½ V. battery as field telephones. Enclosed in a metal case and with a canvas carrying bag. Ideal for House to Garage or Intercom. All NEW less handsets @ $8.95 Ea. ..... $16.95/Pr.

PE 104 VIBRATOR POWER SUPPLY

Part of BC-654 Transformer, Input, 60 R 12V.D.C. Output, 6, 14 and 84 U.D.C. Pos. 1.4, 6, 12 and 51 V.D.C. Neg.
In excellent condition ..... $8.95 Ea.

12 or 24 VOLT VIBRATOR INVERTER

Use for Mobile Radio, Trucks, Boats, etc., where 110 Volt, 60 Cycle is desired. Can be used on 12 Volts or 24 Volts D.C. input, 110 V., 60 cycle, 240 watt maximum output. Uses separate vibrator for each input voltage. In enclosed case, excellent condition $27.50

HEAVY DUTY 12 VOLT BATTERIES

Thor—12 VOLT 220 AMP. HOUR Battery. Use for Trucks, Boats, Bus, Mobile Radio. All New, Dry Charged ..... $29.95 Ea.

Willard or Prestolite 12 VOLT, 68 AMP. HOUR Battery. Use for planes, cars or Mobile Radio with Spill-proof Caps. All New, Dry Charged ..... $14.95 Ea.

RADIO DIRECTION FINDER

BC-1003 Receiver. Frequency Range 100 KC-1000 KC in 3 bands. Has Loops mounted on top with Sense and Balance Circuits, Less power supply. In Exc. Cond. with Tubes ..... $49.95 Ea.
12 V. Input Dyn. for above Receiver ..... $6.95 Ea.

MICA CAPACITORS
FIG. A UPRIGHT MOUNTINGS

MFD.	Ea.	MFD.	Ea.	MFD.	Ea.
1000 V.		2500 V.		.00006	.95
.1	$1.00	.025	2.25	.00005	.95
.07	.95	.00075	1.50	5000 V.	
.062	.90	.0006	1.50	.004	3.50
.05	.85	.00025	1.25	.002	3.25
1500 V.		3000 V.		.0015	3.25
.075	1.25	.006	1.50	.001	3.25
.05	1.10	.005	1.50	.0008	3.25
.039	1.10	.004	1.50	.00075	2.75
.03	1.00	.003	1.50	.0005	2.75
2000 V.		.002	1.50	.00045	2.35
.03	2.25	3000 V.		.0004	2.35
.01	2.00	.000625	1.35	.0002	1.75
.006	1.50	.00055	1.25	.00009	1.50
.005	1.50	.0005	1.25	7500 V.	
.003	1.25	.0004	1.25	.0005	3.95
.00275	1.25	.00025	1.25	8000 V.	
.0025	1.25	.0001	1.15	.01	5.95
.00125	1.00	.00009	1.10	.0006	4.50
.00003	1.00	.00008	1.00	.0005	4.50
		.000075	1.00	.00025	3.95

FIG. B SCREW TERMINAL

500 V.		1200 V.		2500 V.	
.05	1.00	.022	.85	.015	1.60
.04	.85	.02	.85	.01	1.50
.02	.75	.01	.75	.0035	1.25
600 V.		.001	.65	.003	1.25
.01	.65	.005	.50	.002	1.00
.047	.85	1250 V.		.0018	1.00
.03	.75	.03	.95	.0063	.90
.0375	.75	.025	.85	.0006	.90
.02	.75	.01	.80	.0005	.90
.0005	.45	.006	.60	.0004	.85
.00015	.35	.004	.60	.00025	.85
.00005	.35	2000 V.		.00015	.85
1000 V.		.0004	.75	.00005	.75
.01	.75	.00007	.75	3000 V.	
.00005	.50			.005	1.50

SIGNAL LIGHTS

Type K3, 12 Volt Signal Lamps. Portable bakelite enclosed 12 Volt Sealed Beam Light. Use as Flashing Signal or Steady Spot. Comes with mounting bracket for permanent mount with carrying case, and 20 feet rubber covered Heavy Duty Extension Cord.
All New ..... $6.95 Ea.

CAPACITORS • FIXED • OIL FILLED
Solar, Pyranel, C.D., Etc.
ALL D.C. VOLTAGE RATINGS

2	MFD. 400 V.	$0.79	1	MFD. 1000 V.	$1.00
3X3	MFD. 400 V.	1.95	2	MFD. 1000 V.	1.25
10	MFD. 400 V.	2.95	8	MFD. 1000 V.	3.95
1	MFD. 600 V.	.75	10	MFD. 1000 V.	4.95
4	MFD. 600 V.	1.95	1	MFD. 1500 V.	1.50
5	MFD. 600 V.	1.95	4	MFD. 1500 V.	2.25
6	MFD. 600 V.	1.95	1	MFD. 2000 V.	1.95
7	MFD. 600 V.	1.95	2	MFD. 2000 V.	1.95
8	MFD. 600 V.	1.95	3	MFD. 2000 V.	3.50
8x8	MFD. 600 V.	2.25	1	MFD. 3000 V.	3.95
10	MFD. 600 V.	2.25	1	MFD. 5000 V.	5.95
15	MFD. 600 V.	2.95			
20	MFD. 600 V.	2.95			

All Mail Orders Promptly Filled, F.O.B., San Francisco . . . All California Orders—Add 3% Sales Tax . . . Do not send postage stamps. 20% Dep. on all C.O.D. orders. All items subject to prior sale and prices subject to change without notice. On purchases under $5.00 send full amount.

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