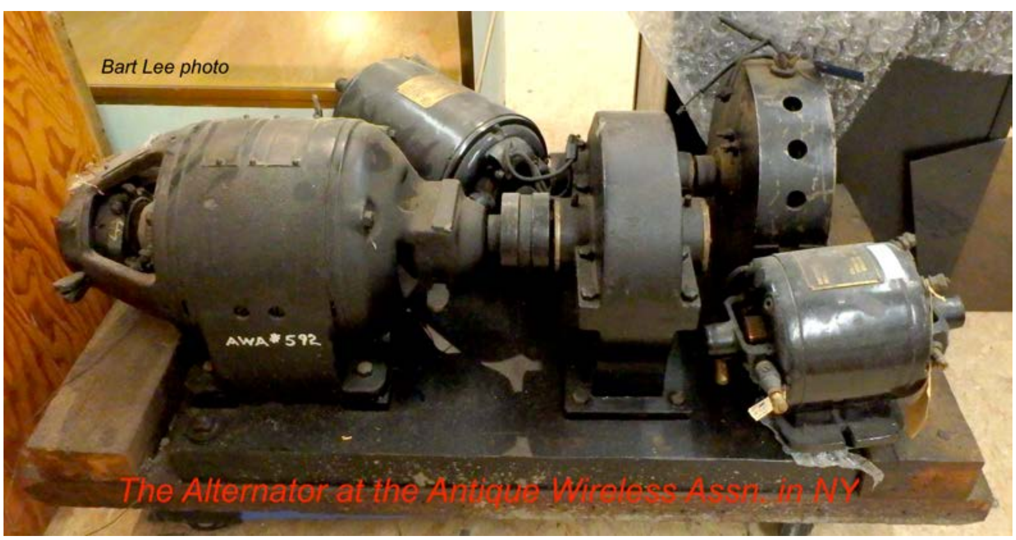
An Alexanderson Alternator Rediscovered at AWA

By Bart Lee, K6VK, CHRS Archivist & Fellow, AWA Fellow

Alexanderson Alternators, by which radio frequency energy (RF) is created mechanically, are few and far between, almost exactly a century later. RCA once hoped to use some twenty of them worldwide, in the VLF part of the spectrum, around 20 KHz. It sited two at Bolinas, CA in the early 1920s, as KET and maybe KEI. The US Navy then used one of them in Hawaii to broadcast to the Pacific Fleet in World War Two. One still operating alternator is the Swedish station callsign SAQ. Several times a year it makes Morse code broadcasts for enthusiasts. California radiomen such as Paul Shinn, CHRS, have logged it. It puts out about 100 kilowatts of RF as an interrupted Continuous Wave emission at 17.2 KHz when keyed.

The Antique Wireless Association in New York holds a small alternator in its collections. It is believed to be operable. An interesting text accompanies it (see below).

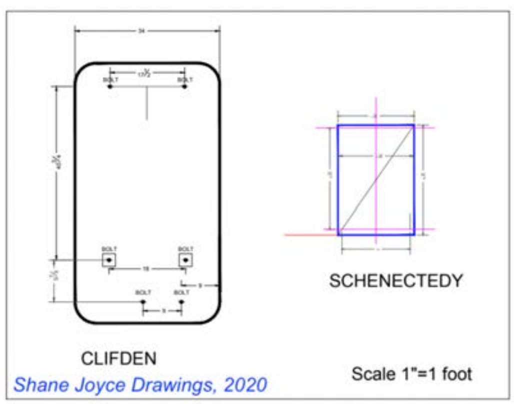


A General Electric Alternator in the AWA Museum

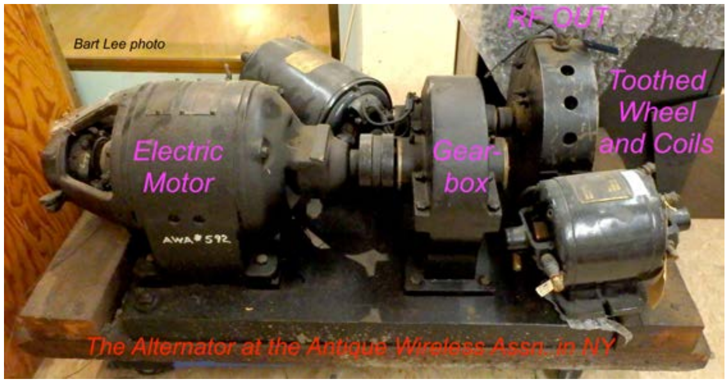
In response to a request from Radio-Archeologist Shane Joyce in Ireland, Bob Hobday, the AWA President and Chair, measured the device:

"The multiple components of the machine are bolted onto a metal cast base. The metal base is 17 7/8 inches by 25 3/4 inches about 3 high. The metal base is mounted to a wood base by four bolts which are spaced 16 inches wide by 23 3/4 inches."

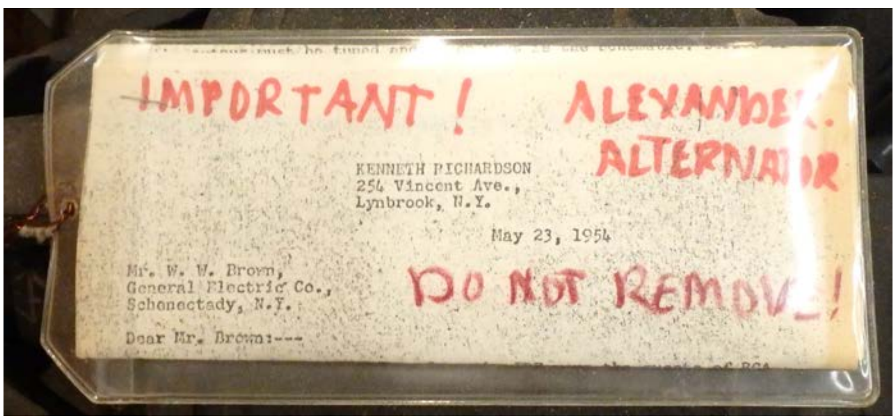
Joyce has explored radio sites in several countries. He had found a base at the old Marconi Clifden, Ireland site that could have held the small alternator that the Marconi company had tested in the 1920s. The AWA Schenectady [NY, GE] alternator is smaller than the Clifden base, but little can be said with any certainty.



In addition to the AWA alternator, a similar one is said to be held in the collections of the New England Museum of Wireless and Steam. Almost all have been scrapped over the years since World War Two. Alternators worked with three primary components, as below:



This alternator is quite small relative to the SAQ types. It is perhaps comparable to the then-new Alexanderson GE alternator that Fessenden used *circa* 1906. Uniquely, this device came with its own provenance documentation.



The packet attached to the device holds original correspondence between the owner and a GE engineer working in the VLF area. As will appear, he was in Greenland at the time, in 1954. One may wonder what a VLF engineer was doing up there in the cold north – in the new cold war, north of the Artic Circle in Western Greenland. A clue lies in the propagation characteristics of the Arctic: auroras and other ionospheric events often black-out high frequency communications depending on the F-layer of the ionosphere. They are not known to affect VLF, at least not in the same ways, because it propagates by ground wave and for long distances, by the D-layer.

The extent, if any, to which the US armed forces used VLF in the Arctic then (or now) is not known. The US Navy now has a worldwide system of VLF digital transmitters. Other NATO countries participate. And of course, the Russians and the Chinese have their own VLF systems. As far as is known, none are alternators.

With the cooperation of the AWA and its archivist Jim Kreuzer, CHRS has had the alternator documentation transcribed, and is authorized to post it. One surprising aspect emerged: its owner intended to use it in ultrasonic experiments. Presumably he would feed the RF output of 750 watts at perhaps 25 KHz into a high power transducer. What may have come of this is not known.

[Archivist's note: There follows a typescript transcription of the three page documentation attached to the Antique Wireless Association artifact "AWA #592".

The letter of inquiry came from Kenneth Richardson. He was Charter Member of the De Forest Pioneers in 1972. He acted as its Secretary; his membership number was 22. His letter refers to: A. W. Aird, another member of the Institute of Radio Engineers, noted in 1922 as Engineer in Charge, Engineering Department, Operating Division RCA (See World Wide Wireless [RCA News], Vol. 3, August 1922 Page [35] via Google Books).

W.W. Brown worked for General Electric for 44 years from about 1914. He then worked for the National Institute of Standards and Technology (then NBS). He devoted himself to VLF (Very Low Frequency) and LF (Low frequency) design, especially antennas.

See M.A. Lombardi & G.K. Nelson, "WWVB: A Half Century of Delivering Accurate Frequency and Time by Radio," Section 9 and Figure 7, Journal of Research of the National Institute of Standards and Technology, 11 Mar 2014, 119:25-54. https://europepmc.org/article/pmc/4487279

W.W. Brown at the National Bureau of Standards

[Continued next page as transcribed typescript >>>]

KENNETH RICHARDSON
254 Vincent Ave.,
Lynbrook, N.Y.

May 23, 1954

Mr. W. W. Brown,

General Electric, Co.,

Schenectady, N.Y.

Dear Mr. Brown:---

Yesterday a number of us from the IRE were the guests of RCA Communications at Rocky Point and at Riverhead, Long Island. There I met Chief Mr. A.W. Aird whom you know personally. He suggested that I write you for some technical data on a historic generator which I secured a few years ago for my collection. It is an Alexanderson HF Alternator. There was no data accompanying it except the nameplate which is almost devoid of data, and is reproduced on page 2. From observation I find the rotor measures 7 1/2" in diameter and about 3/4" thick; 150 steel poles sat in phosphor-bronze, with steel rim and revolving between two stator fields excited by ring coils of about 60 ohms DC each, field wire size about 25 to 27 plain enameled, each field separately brought out for either series or parallel connections. Apparently, to be excited by about 60 volts DC at 1/2 ampere when connected in series. Each stator has 300 poles with wire of small size (or ribbon?), and with separate terminations. The relation of the pole angle of one stator is adjustable, evidently for proper phasing with the other set of stator poles.

Could you supply the missing data shown on the nameplate, and advise what the no-load voltage of the output is; whether or not the output must be tuned and if so what is the schematic; series or parallel tuning, and the constants; whether it is safe to operate at any time with load removed or detuned, etc. Normal loaded voltage and current at 10,000 RPM? Means for obtaining speed stability, etc.? Instruction booklet available? Upon receiving sufficient data I will want to set up the machine into experimental operation for ultra-sonic experiments, as well as to have a fine historic piece in my collection.

Any data applying to this machine would be greatly appreciated. Many thanks.

Yours truly,
Kenneth Richardson

May 23, 1954

P.S. Also what was the original use of this generator? I was with GE Co., Erie works many years ago.

(See page 2,
(transferred here >>
Size 11⁄2″ x 3″ >>
N.P. 6925

ALTERNATING CURRENT GENERATOR

No. 20814

Type ASC 300-0.75-25000 Form A

P.F. ______ Phase. AMP. _____

K.W. 3/4 VOLTS___________

Speed 10,000
Cycles 25,000

____

General Electric Co.,

Schenectady, N.Y.

GENERAL ELECTRIC

W.W. Brown

2004th AACS Squadron

APO 121, c/o Postmaster

New York, N.Y.

Sonderestromfjord Air Base

Greenland.

24 June, 1954

Mr. Kenneth Richardson,

254 Vincent Avenue,

Lynbrook, N.Y.

Dear Mr. Richardson:

Your letter of May 23, 1954, addressed to me at Schenectady, in which you inquired about a small Alexanderson Alternator, was received here 19 June. Sorry for the delay.

The Alexanderson High Frequency Alternator which you described is presumably one of several used in General Electric laboratories about 1912 to 1915. They were used in connection with the development of radio apparatus in general, particularly the Alexanderson system of radio transmission and reception.

Each unit consisted of the alternator, driving motor and step up mounted on a cast iron base. The DC motor rated approximately 10 HP at 2000 RPM provided for convenient operation thru a wide range of speed and frequency. The gear ratio was approximately 1 : 5. Nominal rating of the alternator was 750 watts.

If you have the complete assembly and desire to use it, suggest the following:

1. Clean the apparatus thoroughly. Disassemble the alternator in order to thoroughly clean the armatures, rotor and bearings. In reassembling the alternator, adjust the airgap on each side of the rotor to approximately .020".

2. With the alternator running at say 5000 RPM, apply a low value of field excitation and measure the open circuit voltage on the armature on each side of the rotor. A tube voltmeter would be suitable instrument for measuring these voltages. If the two values differ more than 5%, stop the alternator and decrease the airgap slightly on the side which had the low voltage. Again measure and continue this process until essentially the same voltage exists on both armatures.

3. Connect the two armatures in series and measure the open circuit voltage across each armature and across the outer terminals. By very small rotation of one armature with reference to the other, (with machine stopped) phase relations should be obtained in which the outer terminal voltage would be substantially the sum of the individual voltages.

4. The armature windings on opposite sides of the rotor may be connected in series or parallel; but generally, the series connection is preferable, due to absence of circulating currents (which exist) in the parallel connection.

5. Take a saturation curve of the alternator with speed held constant at say 5000 RPM. Measure field amperes and open circuit voltage. This will indicate nominal values of excitation and output voltages for subsequent use. Suggest not exceeding 50 volts across the two armature windings in

series.

6. Determine internal impedance of the alternator by measuring open circuit voltage and short circuit current, with low field excitation and constant speed. Impedance ohms will be the open circuit volts divided by the short circuit current. This value of ohms, times load current which may be subsequently used, will give volts across the alternator terminals.

7. By connecting the mid connection between the two armatures in series to the alternator frame, voltages between armature windings and armature iron may be minimized.

8. Limitations of output should be 50 volts total across the armature windings in series, or temperature of the alternator armature. Suggest nominal limit of 55 degrees C actual temperature as determined by thermometer on the alternator frame nearest to the back of the armatures.

9. All characteristics will vary with speed and frequency. Open circuit voltage will vary nearly directly with frequency, for given field excitation. Frequency at 10,000 RPM will be 25,000 cycles.

10. Suggest nominal limitation of armature current at 5 amperes with windings in series or 8 amperes with windings in parallel.

11. There are innumerable ways to use the output of the alternator. Internal reactance may be neutralized by an external capacitance but in this case, be cautious that nominal rated current and voltage are not exceeded. Transformer may be used to provide wide range of volt-ampere load requirements.

Wish you success in your efforts. A tip on armature connections: It is obviously possible to connect the two armatures in series bucking as well as boosting. Some years ago, a customer having a larger machine with two separate armature windings, was unable to obtain any output. After a trip of several hundred miles, the only thing found wrong was the two voltages were bucking instead of boosting. So be sure to boost 'em.

Very truly yours,

W. W. Brown.

[s//] W. W. Brown.

CC Dr. Alexanderson
Mr. Herzog [END]

== == ==

(16 XII ’21, v2, for CHRS de K6VK) ##