

Ottawa Vintage Radio Club

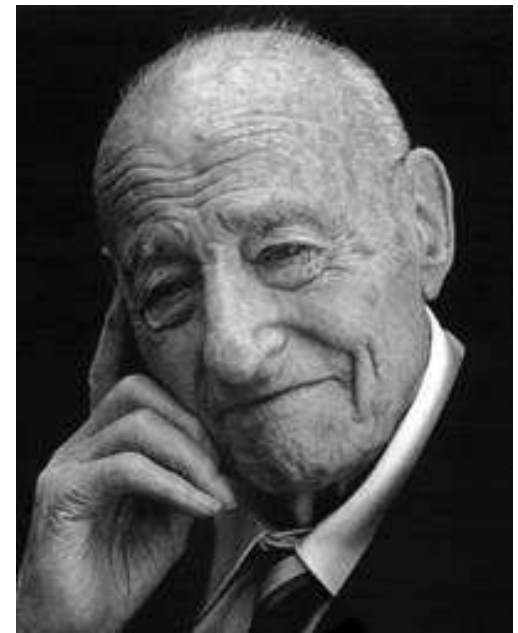
Feb 9, 2021

From the January Meeting...

“The walkie-talkie was first invented in 1937 by the Canadian Don Hings, with many similar devices being developed by other inventors around the same time.” ← twoway-radio.co.uk

Inventor of the Walkie-Talkie

- Donald Lewes Hings 1907 – 2004 Burnaby, BC
- Don was born in Leicester, England, November 6, 1907, and moved to western Canada as a young boy. He was a pioneer in the field of telecommunications, and best known for his invention of the Walkie-Talkie during WW II. In 1946 he was awarded the Member of the British Empire by King George VI and fifty-five years later in 2001 he was presented with the Order of Canada by Governor General Adrienne Clarkson. Self-taught, he was a lifetime member of the Professional Engineers Associations of BC and Ontario, the American Geophysical Union and the Canadian Signal Corps where he had been very adept at tapping Morse Code. VE7BH was his HAM radio call sign, with which he talked to the "HAM boys" well into his 90s.
- His life work includes a wide-range of antenna, radio technologies and geophysical exploration techniques using electromagnetic instrumentation that he developed. He has more than 55 patents to his name in both Canada and the US. Hings was described by his US Patent Attorney as being the most creative thinker he had ever encountered.
- The presence of this unassuming pioneer and family man shall live on in the hearts of all who knew him, and his influence within the realm of communications shall continue to unfold.



Hings

- Invented the walkie-talkie* while at “The Consolidated Mining and Smelting Company” (later Cominco). They lent him to DND and NRC in Ottawa for the duration of the war.
 - About 18000 of the model 58 were produced at “A Toronto Refrigerator Factory” (surprised that it was not built at REL, given their close collaboration with NRC)
 - After the war, he established “Electronic Labs of Canada” in BC.
- * The term “walkie-talkie” was coined by a Toronto news reporter.



Hings References

- <http://www.dlhings.ca/obituary.html>
- <http://dlhings.ca/walkietalkie.html>
- <https://static1.squarespace.com/static/5b11caa631d4df0138d9dfdb/t/5f3dba6e8243174c830a79b1/1597880964053/Hings+Walkie+Talkie+Brochure.pdf>
- <https://www.hyperstealth.com/DonHings/>
- <https://www.hyperstealth.com/DonHings/Don-Hings-Walkie-Talkie-Development.PDF> <--- very good article, in-depth
- “The walkie-talkie was first invented in 1937 by the Canadian Don Hings, with many similar devices being developed by other inventors around the same time.” ← twoway-radio.co.uk

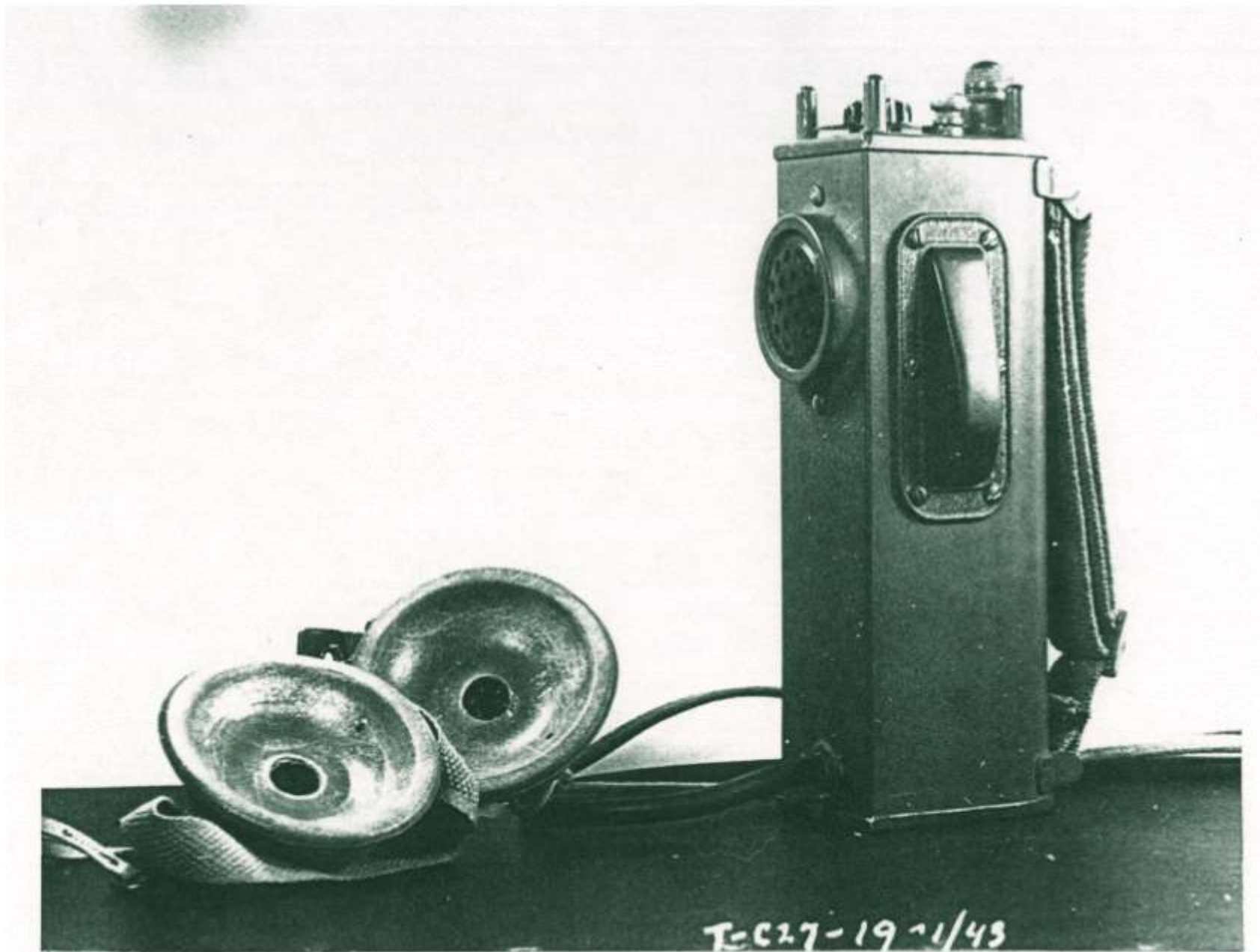


Walkie-Talkie



#58 Mk 1 Wireless Set

Walkie-Talkie



1943

CANADIAN HANDIE-TALKIE

Walkie-Talkie



Dr. Seuss's Electro Who-Cardio Floox

Vintage Electronic Musical Instruments

- organs
- theremins
- guitar amplifiers
- stomp boxes (fuzz box, wah-wah pedals, reverb, flangers, vibrato, tremolo)
- talk boxes
- Leslie speakers
- vintage musical tuners <https://my.ptg.org/foundation/museum/etds>
- music synthesizers (Moog or Roland or whatever)
- anything to do with musical instruments

Vintage Electronic Musical Instruments

- I will talk about:
 - Early Instruments
 - The Theremin
 - Moog
 - Guitar Amplifiers
- Thanks to Alain, Sylvain, JP, and Lea for contributions.
- All other musical topics are very much on the table.

Electronic Musical Instruments thru the Ages

- There is a great web site with the history of electronic musical instruments:
- 120 years of electronic music: www.120years.net By Simon Crab.
- Here are some highlights from it...



Very very early....

- 1748: Denis D'Or: Several accounts describe the instrument as an electro-acoustic instrument where the strings are vibrated using electro-magnets. Czech republic.

Electro-Harmonic Telegraph

- Elisha Gray invented many things (according to some, the telephone), including an early electronic instrument.
- He also went on to co-found Western Electric.
- Gray discovered that he could control sound from a self-vibrating electromagnetic circuit and in doing so invented a basic single note oscillator. (really, a buzzer)
- The original intention was to use this principle to develop an early version of multiplex telegraphic transmission; sending multiple telegraphic messages encoded as different pitches simultaneously over the same line which could be decoded at the receiving end.
- Using this principle he designed a musical instrument; The 'Musical Telegraph' or 'Electro-Harmonic Telegraph' initially to demonstrate and promote his ideas.

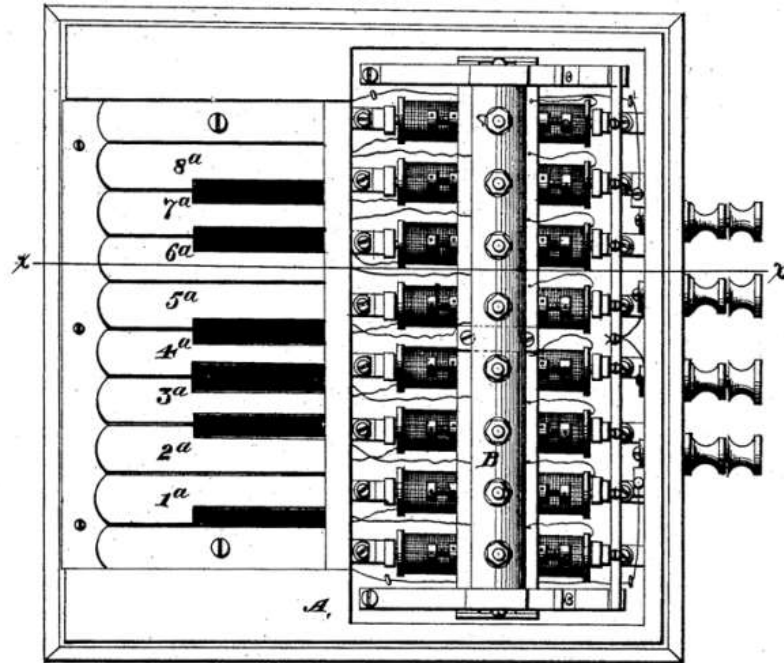
E. GRAY.

ELECTRO-HARMONIC TELEGRAPH.

No. 173,618.

Patented Feb. 15, 1876.

Fig. 1.



WITNESSES
Wm. J. Payson.
J. Allen

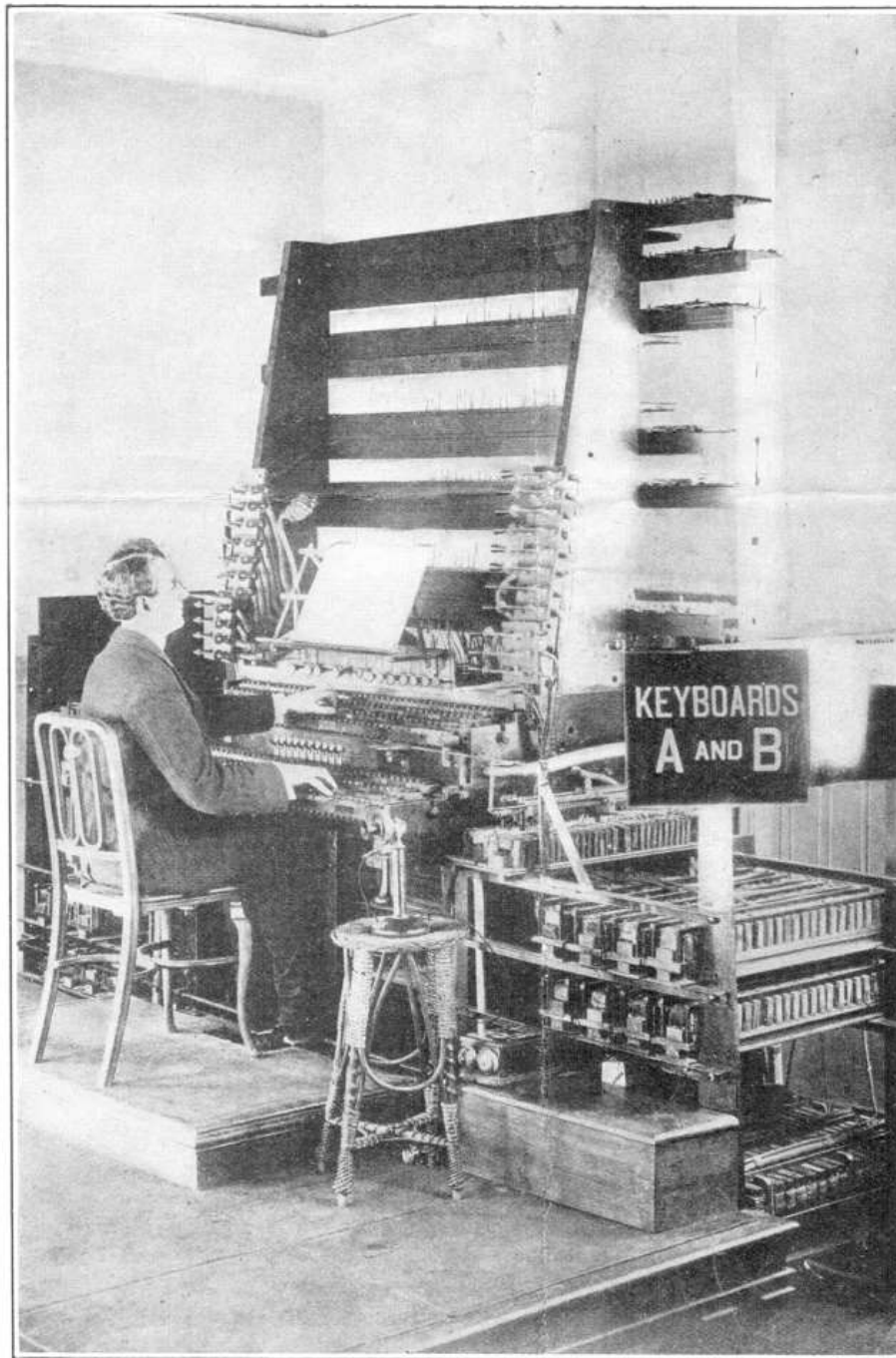
Elisha Gray INVENTOR
 By *his* Attorney
Wm. Baldwin

T Cahill's
Telharmonium
1897

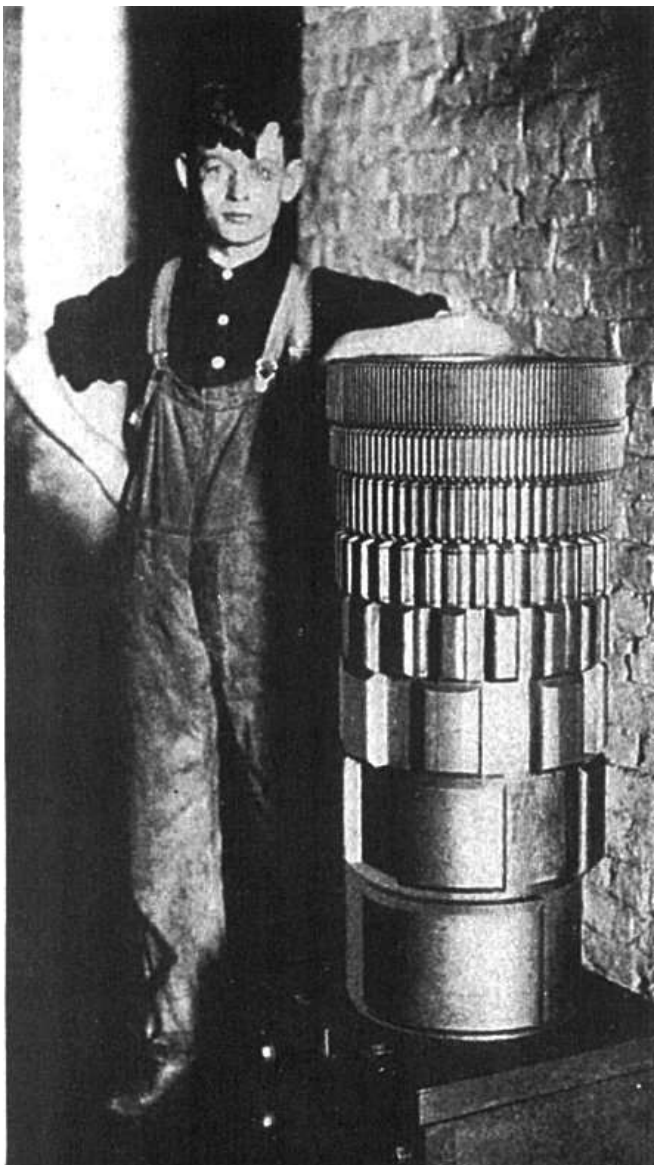
AKA
Dynamophone

MK1 was 14000lbs

Spinning rotors that
induced audio into
electromagnets (or
sometimes brushes)



THE KEYBOARD OF THE TELHARMONIUM



(No Model.)

10 Sheets—Sheet 2.

T. CAHILL.
ART OF AND APPARATUS FOR GENERATING AND DISTRIBUTING MUSIC
ELECTRICALLY.

No. 580,035.

Patented Apr 6 1897

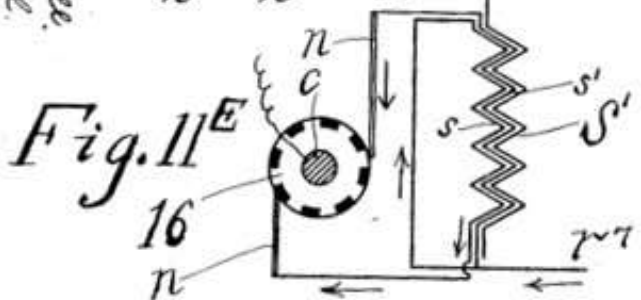
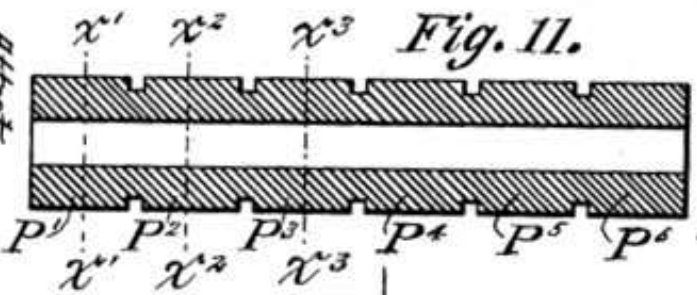
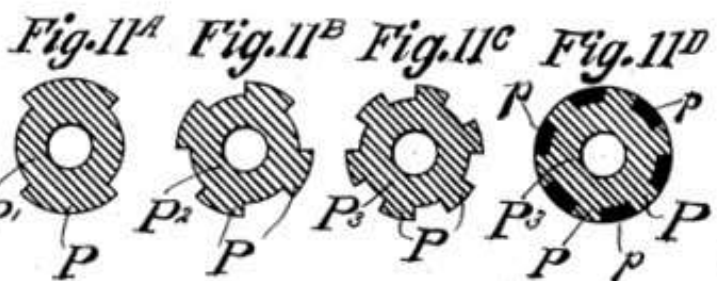
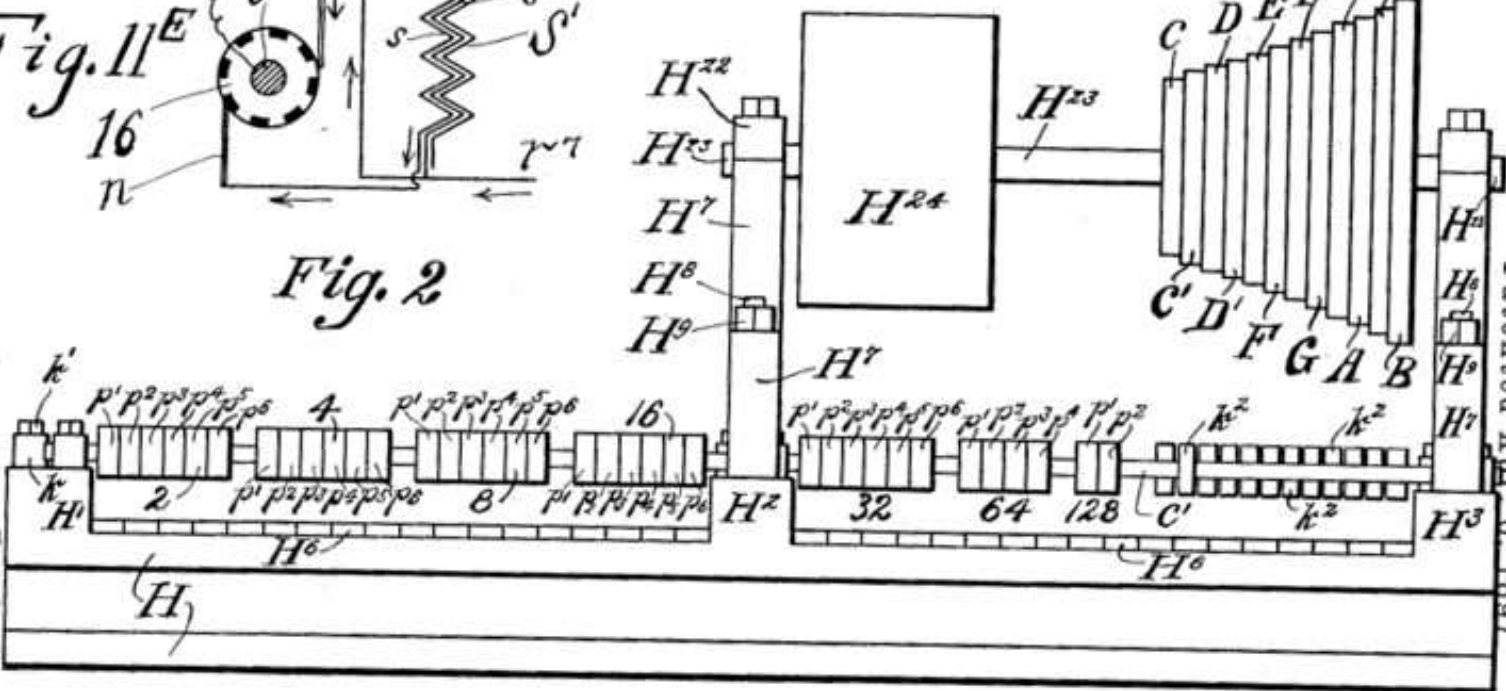


Fig. 2



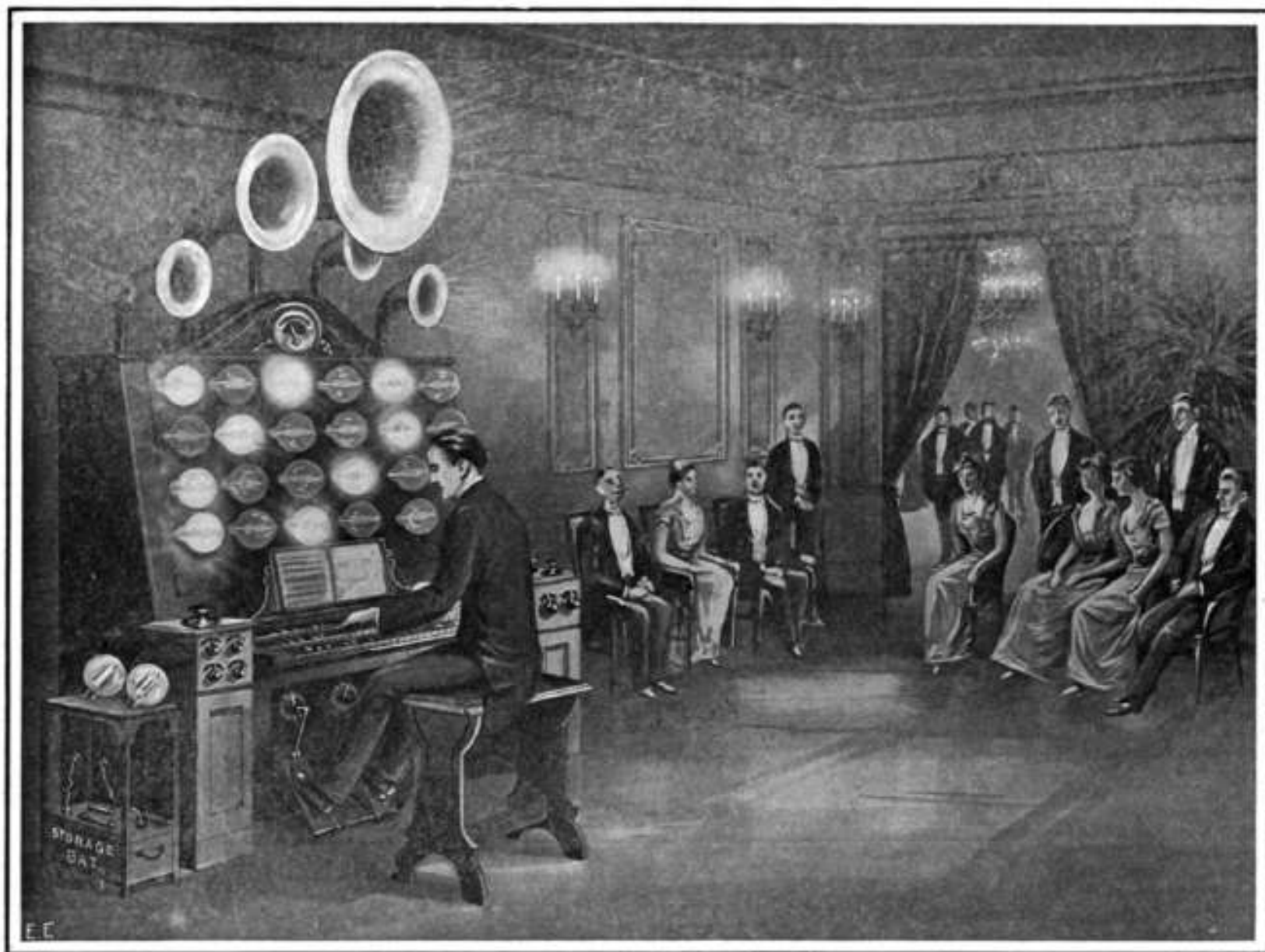
Attest:
Arthur J. Cahill,
M. H. Cahill.

Inventor:
Thomas Cahill.

The 'Audion Piano' and Audio Oscillator. Lee De Forest.

- Lee De Forest, well known to radio people, had among his many inventions (both real and imagined) the “Audion Piano”.
- Not truly a complete instrument, it could play only 1 note per octave, based on an audion oscillator.
- He had plans for a more complex instrument capable of more tones, but it appears that they were not completed.
- “The Audion Piano, controlled by a single keyboard manual, used a single triode valve per octave, controlled by a set of keys allowing one monophonic note to be played per octave. This audio signal could be processed by a series of capacitors and resistors to produce variable and complex timbres...”

<https://120years.net/wordpress/the-audion-piano-lee-de-forest-usa-1915/>



The Audion Piano May Entertain Us in the Near Future With Music Purer Than That Obtainable With Any Instrument Now Available. Also It Will Imitate Faithfully Any Orchestral Piece.

The 'Désilets Wireless Organ'. Georges Désilets, Canada, 1914.

- Canada was involved, too!
- This was essentially a spark transmitter with the alternator designed to produce a series of tones based on the pitch of the spark electrodes.
- Near Trois-Rivieres

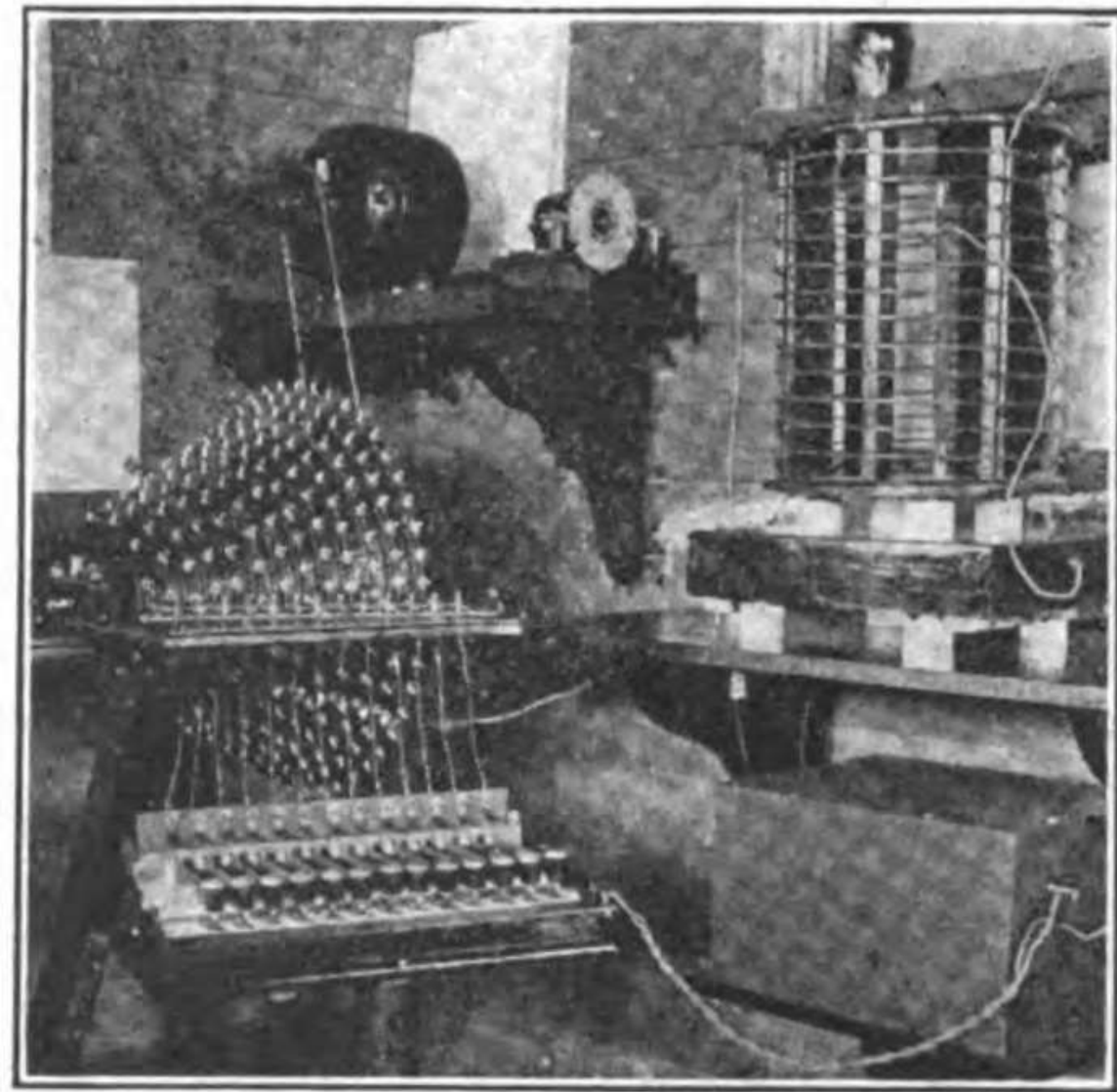


Fig. 2—First Model of the Original Radio Organ Constructed by the Inventor in 1916.



The Reverend Georges Désilets, Inventor of the Radio Organ.

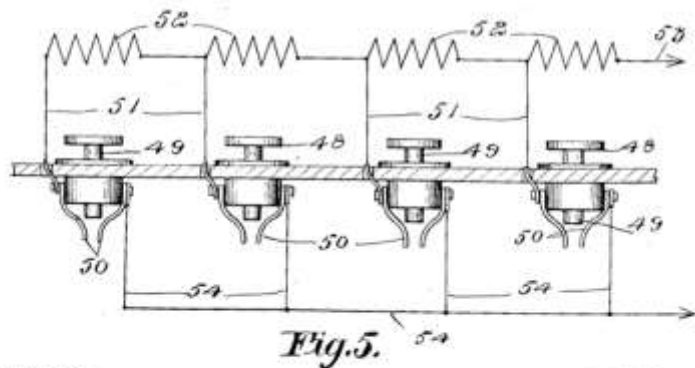
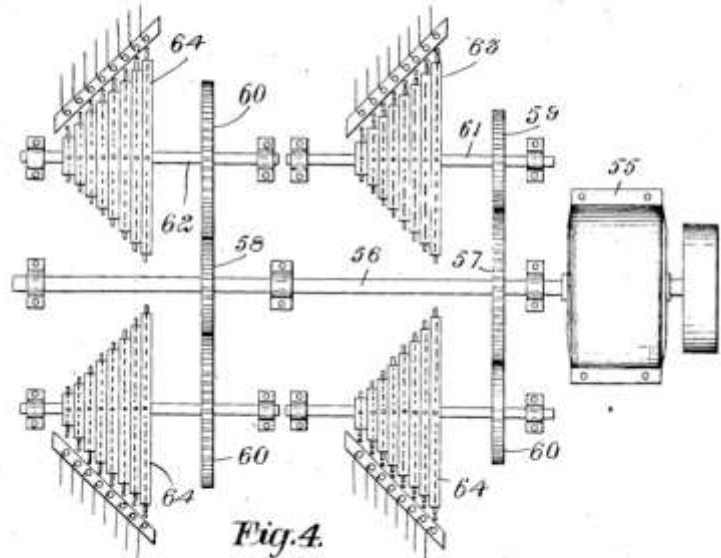
Georges Désilets was born in Nicolet, Quebec, Canada on November 29, 1866, the son of Isaiah Désilets, farmer and Léocadie Belcourt. After studying classics and theology at the Séminaire de Nicolet (1880-1888), he was ordained as a priest on July 26, 1893.

1,166,582.

Patented Jan. 4, 1916.

3 SHEETS--SHEET 3.

Fig. 1.

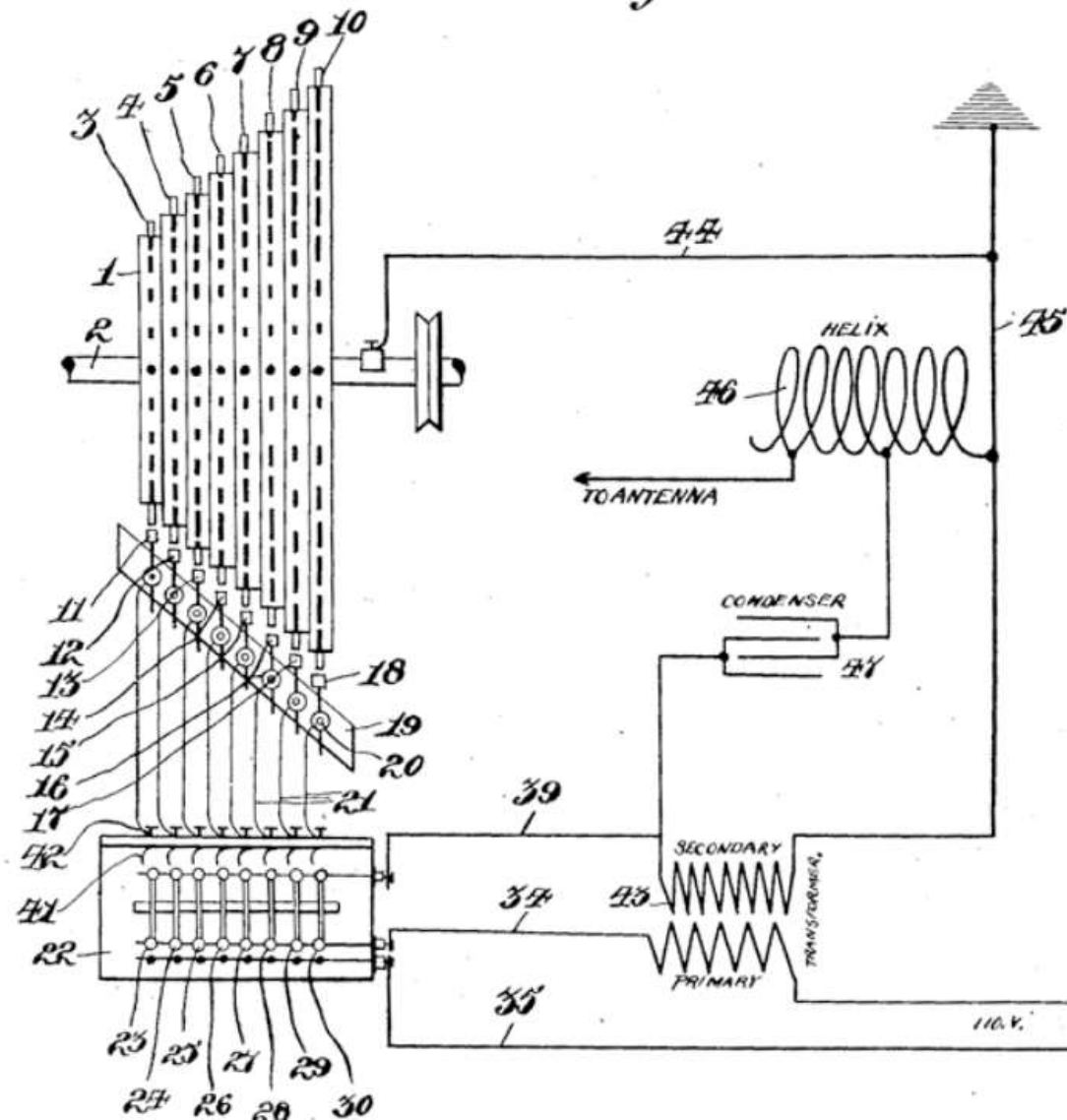


WITNESSES:

D. Latensude
M. Latensude

INVENTOR

Georges Desilets
BY *Lipson Sigman Davis*
ATTORNEY



Jörg Mager, Germany.

- Wins the award for the best and widest selection of instrument names.
- The Electrophon (1921),
Sphäraphon(1924), ← used heterodyning, like the Theremin.
kurbelsphärophon (1926),
Klaviatursphäraphon(1928),
Partiturophon (1930) and
Kaleidophon(1939).

There are others...

- **Pre 1800**
- 1748: Denis D'Or
- 1759: Clavecin Électrique
- 1785: Clavecin Magnetique
- 1800 – 1900
- 1867: Electromechanical Piano
- 1876: Musical Telegraph
- 1897: Telharmonium
- 1899: Singing Arc
- **1900 – 1920**
- 1905: Helmholtz Sound Synthesiser.
- 1909: Choralcelo
- 1915: Audion Piano
- 1912: Sound-Producing Device
- 1914: Wireless Organ
- 1916: Optophonic Piano
- 1918: Synthetic Tone

There are more...

- **1920 – 1930**
- 1921: Electrophon
- 1921: Hugoniot Organ
- 1922: Theremin
- 1923: Staccatone
- 1924: Sphäraphon
- 1925: The Luminaphone
- 1925: Radio Harmonium
- 1926: Pianorad
- 1926: Keyboard Electric Harmonium
- 1926: Kurbelsphärophon
- 1927: Dynaphone
- 1927: Cellulophone
- 1927: Clavier à Lampes
- 1927: Electronde
- 1927: Robb Wave Organ
- 1927: Superpiano
- 1927: Neo Violena
- 1928: Ondes-Martenot
- 1929: Orgue des Ondes
- 1928: Klaviatursphäraphon
- 1929: Croix Sonore
- 1929: Hellertion & Heliophon

And more...

- **1930 – 1940**

- 1930: Coupleux-Givelet Organ
- 1930: Rhythmicon
- 1930: Ondium Péchadre
- 1930: Graphical Soundtrack
- 1930: Partiturophon
- 1930: Trautonium
- 1930: Hardy-Goldthwaite Organ
- 1930: Westinghouse Organ
- 1930: Magneton
- 1931: Radio Organ of a Trillion Tones, Polytone Organ & Singing Keyboard
- 1931: Saraga-Generator
- 1932: Vibroexponator
- 1932: Variophone
- 1932: Emicon
- 1932: Rangertone Organ
- 1932: Terpsitone
- 1932: Gnome
- 1932: Electrone
- 1933: Electrochord & Kdf Grösstonorgel
- 1934: Syntronic Organ & Photona
- 1934: Aetherwellengeige
- 1934: Singing Keyboard
- 1935: Hammond Organ
- 1935: The Jowiphon
- 1936: Sonothèque
- 1935: Marimbalite
- 1936: Welte Licht-Ton-Orgel
- 1936: Companola
- 1936: Mixturtrautonium
- 1937: Melodium
- 1937: Oscillon
- 1937: Warbo Formant Orgel
- 1937: Ekvodin
- 1939: Novachord
- 1939: Kaleidophon

These will all be on the exam

- **1940 – 1950**

- 1940: Ondioline
- 1940: Multimonica
- 1940: Voder & Vocoder
- 1940: Solovox
- 1940: Univox
- 1943: Emiriton
- 1945: Hanert Electric Orchestra

- 1945: Thyratone

- 1945: Electronic Sackbut
- 1946: Minshall Organ
- 1946: Tuttivox
- 1946: Baldwin Organ
- 1947: Melochord
- 1948: Free Music Machine

- **1950–1960**

- 1950: Electronium
- 1950: Lipp Pianoline
- 1951: RCA Synthesiser I & II
- 1951: CSIR Mk1 & CSIRAC
- 1951: Dr Kent's Electronic Music Box
- 1951: Chamberlin
- 1951: Ferranti Mk1
- 1951: GRM

- 1951: Wobble Organ
- 1951: WDR Electronic Music Studio
- 1952: Clavivox
- 1953: Composer-tron
- 1955: RAI Studio
- 1955: Fotosonor
- 1957: MUSIC N
- 1957: ANS Synthesiser
- 1958: Fonosynth
- 1959: Oramics
- 1959: Sound Processor
- 1959: Siemens Synthesiser
- 1959: Wurlitzer Side Man

Finally....

1960–1970

1961: DIMI & Helsinki Electronic Music Studio

1963: Mellotron & Novatron

1963: Akaphon

1963: Syn-ket

1964: Beauchamp Synthesise

1964: Moog Synthesisers ← **more on this later!**

1965: Graphic 1

1966: Tubon

1966: Coupigny Synthesiser

1967: Stylophone ← **more on this later!**

1967: MUSYS

1969: EMS Synthesisers

- **1970 – 1980**

- 1970: Subharchord

- 1970: Archifoon

- 1970: Buchla Synthesisers

- 1970: ARP Synthesisers

- 1971: Allen Computer Organ

- 1971: Triadex Muse

- 1972: Qasar I,II & M8

- 1972: Motorola Scalatron

- 1976: Hal Alles Synthesiser

- 1977: Synclavier I & II

- 1977: Con Brio ADS

- 1977: Samson Box

- 1977: UPIC system

- 1977: DMX-1000

- 1979: Fairlight CMI

The Theremin

- Like all topics in vintage electronics, Lea Barker has discussed the theremin already, see the Winter 2019 edition of the newsletter.
- A theremin is an electronic musical instrument that produces a pure musical tone whose amplitude and pitch can be varied by the placement of the musician's hands.
- Invented by Russian Leon Theremin (in Russian, Lev Sergeyevich Termen) circa 1920, coming out of research on proximity fuses.



Leon Theramin at the Theramin!

It's the 100th Anniversary of the Theremin!

By Lea Barker

On CBC radio I heard that 2019 was the 100th anniversary of the invention of the Theremin by Leon Theremin.

This date is disputed by the *Wikipedia* article on the instrument, which puts its invention in the year 1920. So I might be jumping the gun by one year with this article, but since this is my last issue of the newsletter as editor, I thought I should strike while the iron is hot, so to speak.

The theremin resulted from a



Leon Theremin



Clara Rockmore

possibly abducted or convinced to go by Russian agents, and only returned to the USA in 1991.



The RCA Theremin

The photo below shows your editor trying a Theremin at the Science Museum.



Theremin

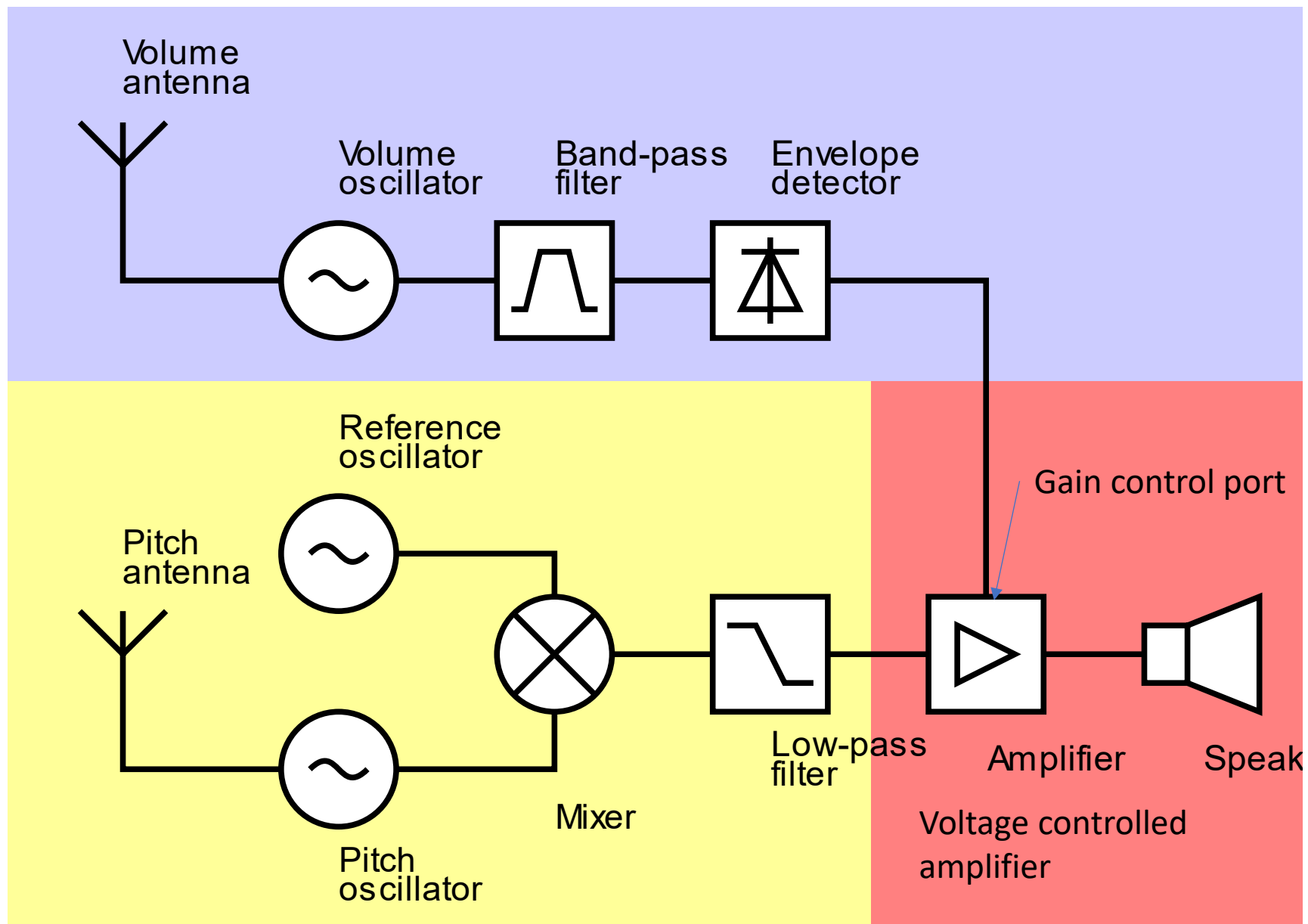
- Leon Theremin toured his instrument through Europe and North America.
- In 1928 in America, he patented it and granted RCA the rights. RCA made a commercial version, the “thereminvox”.
- It was not a financial success for RCA, but the instrument garnered significant public attention.
- Leon left the US in 1938, reasons are varied and controversial.
- After the war, several simpler instruments were introduced, and the theremin became a niche instrument, but a favorite for tinkerers.

Classical Theremin Operation: Pitch

- If you have serviced a superheterodyne AM radio, you will know that placing your hand near the LO “Local Oscillator” (in particular, one section of the variable capacitor) will shift the tuning of the radio. Called the proximity effect.
- Your hand is changing the frequency of the LO because of its capacitance.
- A theremin has two RF oscillators operating at almost the same frequency; one is exposed and sensitive to the musician’s hand, the other is shielded.
- Their outputs are mixed to produce an audio frequency equal to the difference in frequency between the two oscillators. So, pitch depends on the hand proximity to the exposed oscillator.

Classical Theremin Operation: Volume

- The robustness of an oscillation depends on the how much energy is absorbed by the surroundings.
- A “Grid Dip Oscillator” senses how much energy is being absorbed by the surroundings by looking at grid current.
- In a theremin, a second oscillator (not same oscillator used for pitch) grid current (or oscillation amplitude) controls a voltage-controlled amplifier. The position of the musician’s hand changes the grid current (or oscillation amplitude), which changes the volume of the tone produced.



WHAT IS THE VICTOR THEREMIN?

The Theremin is an instrument which produces musical sound by exclusively electrical means. It has no keyboard, strings, reeds or other mechanical aids or sources of sound. It employs RCA Radiotrons, two metal bars as antennae, and a loud-speaker. One antenna—a straight, perpendicular bar, controls tone, or pitch—or, if you like, the “voice” of the Theremin. The other antenna, a looped horizontal bar, controls volume, or intensity of sound.

When any object, such as the human hand, is brought into the sensitive electric field surrounding the vertical antenna, the field is so affected that audio-frequencies (sounds) are produced. These are amplified through the loud-speaker. As the hand approaches the antenna, the pitch of the sounds becomes higher; as the hand is withdrawn, the pitch becomes lower.

The other antenna is also affected by the proximity of the hand. As the hand approaches it, the power of the Theremin's voice is lessened,



Victor Theremin



Simple and graceful movements of the hands produce and control the tone of the Victor Theremin. The young lady is playing a note of rather high pitch (note position of right hand) and powerful volume (controlled with left hand)

and strings; the violin, a bow and stretched strings . . . and so through all the conventional instruments, which interpose some sort of mechanism between the music and the player.

But the Theremin answers to the movement of your hand. For the music leaps into being from the ends of your fingers . . . it is, as it were, an extension of yourself. It is vitally and literally your music, brought into being by your body itself. It may be music in its ultimate and greatest form . . . it certainly is music that will thrill you beyond words with its beauty, its power, its endless variety, its expressiveness—and most of all with the consciousness that you yourself have created it!

See . . . hear . . . play the VICTOR THEREMIN and know the keenest thrill of your life!

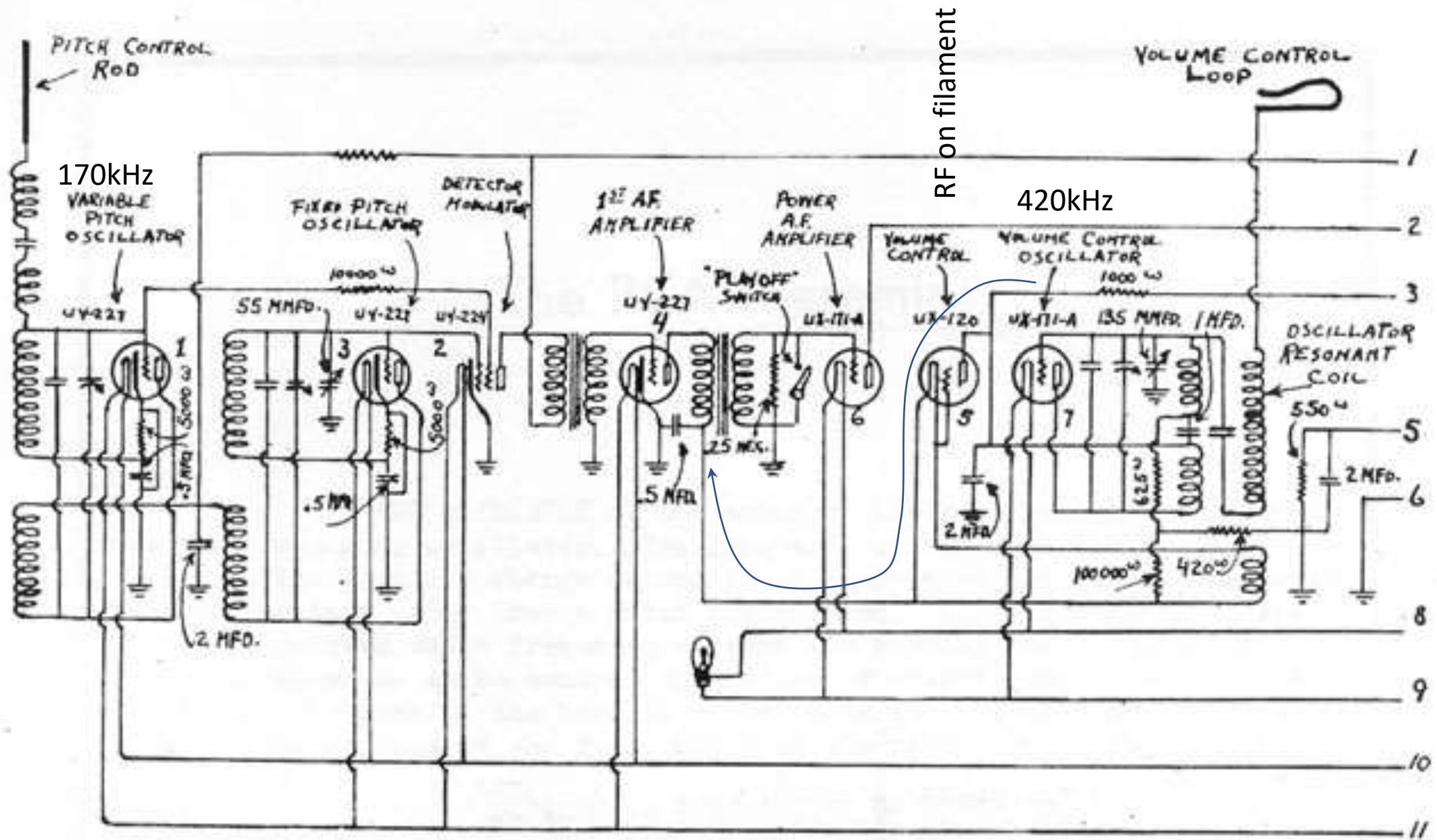


VICTOR DIVISION
RCA Victor Company, Inc.
CAMDEN · NEW JERSEY

<https://www.rcatheremin.com/index.php>



<http://thereminworld.com/>
<https://120years.net/wordpress/the-thereminleon-termensoviet-union1922/>







Alexandra Stepanoff 1930

By What's On the Air Company -
What's On the Air, July 1930
(page 45), Public Domain,
<https://commons.wikimedia.org/w/index.php?curid=56188934>



Modern Theremin Performance

KATICA ILLÉNYI - Once Upon a Time in the West





1994 Movie

"A documentary about the amazing life of Leon Theremin, inventor of the theremin, the electronic musical instrument so beloved of 50s sci-fi movie music. Theremin amazed America with his instrument until his kidnapping by Soviet agents in the mid-30s. Upon his release from a labor camp, he worked on surveillance devices for the KGB. Almost 60 years later, he is brought back to America for a touching reunion with his friends and colleagues."



The Spawn of the Theremin

- The Electro-Theremin (used in Good Vibrations, My Favorite Martian), was developed by Bob Tanner, used a slide mechanically driving a pot on a sine-wave oscillator. →
- Trautonium, Presephone, Electronde,
- The list goes on!



Try this at home, kids!

- A three radio theremin (Super Theremin, スーパーテレミン) invented by Tomoya Yamamoto (山本智),
- Composed of three independent radio sets.
 - Radio set #1 is to listen and to record the signal at around 1600 kHz.
 - Radio set #2 is tuned at 1145 kHz so that its local oscillator of around 1600 kHz is to be received by radio set #1.
 - Radio set #3 is also tuned at 1145 kHz so that its local oscillator may produce the beat with radio set #2.
- Operator's hand movement around bar antenna of radio set #3 may affect the local oscillator to produce tonal change.[80]

Rhymes with “Rogue”

Robert Moog

- Robert Moog became fascinated in the theremin in high school in the 50's
- He designed many theremins, and offered theremin kits for sale.
- He published an article in Radio and Television News on 1954 (at the age of 19).
- Theremins started a career that made Moog's name a household word*: the Moog Synthesizer.
- Moog: *“Leon Theremin's original designs are elegant, ingenious and effective. As electronics goes, the theremin is very simple. But there are so many subtleties hidden in the details of the design. It's like a great sonnet, or a painting, or a speech, that is perfectly done on more than one level.”*

*Well, maybe not every household. A quick survey yielded some blank faces!

SHORTLY after vacuum-tube radios were first put into production, experimenters began to look for other uses for vacuum-tube circuits. One of the early developments was a unique musical instrument, played by the free movement of the performer's hands in the space surrounding the instrument. This device, named the "Theremin" after its inventor, Leon Theramine, attracted widespread attention. Today, Theremin music is still quite popular, despite the fact that no new instruments have been built commercially for about twenty-five years.

Musically, the Theremin is capable of a great deal of individualism and expression. The pitch is controlled by varying the distance between one hand and a control rod. Volume is similarly controlled with the other hand. There are no keys or "notes" on the Theremin. The position of the performer's hands is the only factor that determines the pitch and volume of the sound.

As an electronic instrument using up-to-date circuits and tubes, a Theremin may be constructed at a very nominal cost, and give completely satisfactory performance. In the instrument about to be described, the tone is produced by two radio-frequency oscillators beating at an audible frequency. The addition of hand capacity to the pitch control antenna lowers the frequency of one of the r.f. oscil-

THE THEREMIN

By **ROBERT MOOG, K2AMH**

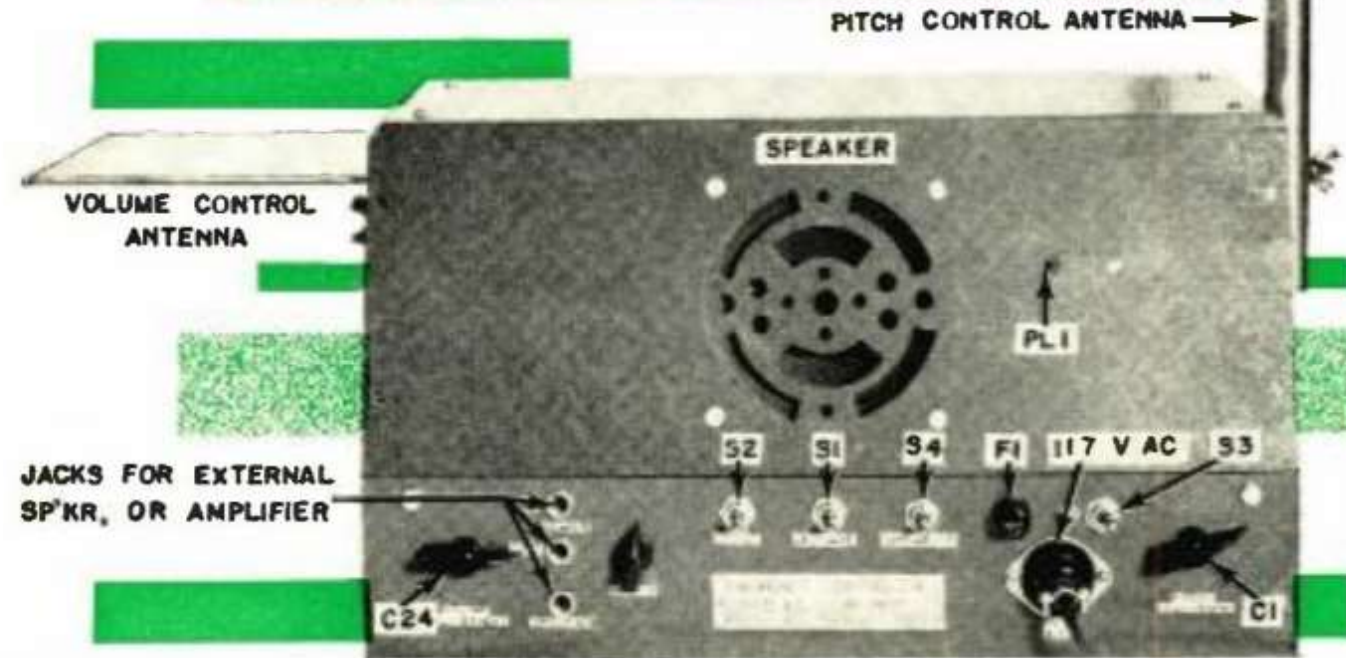
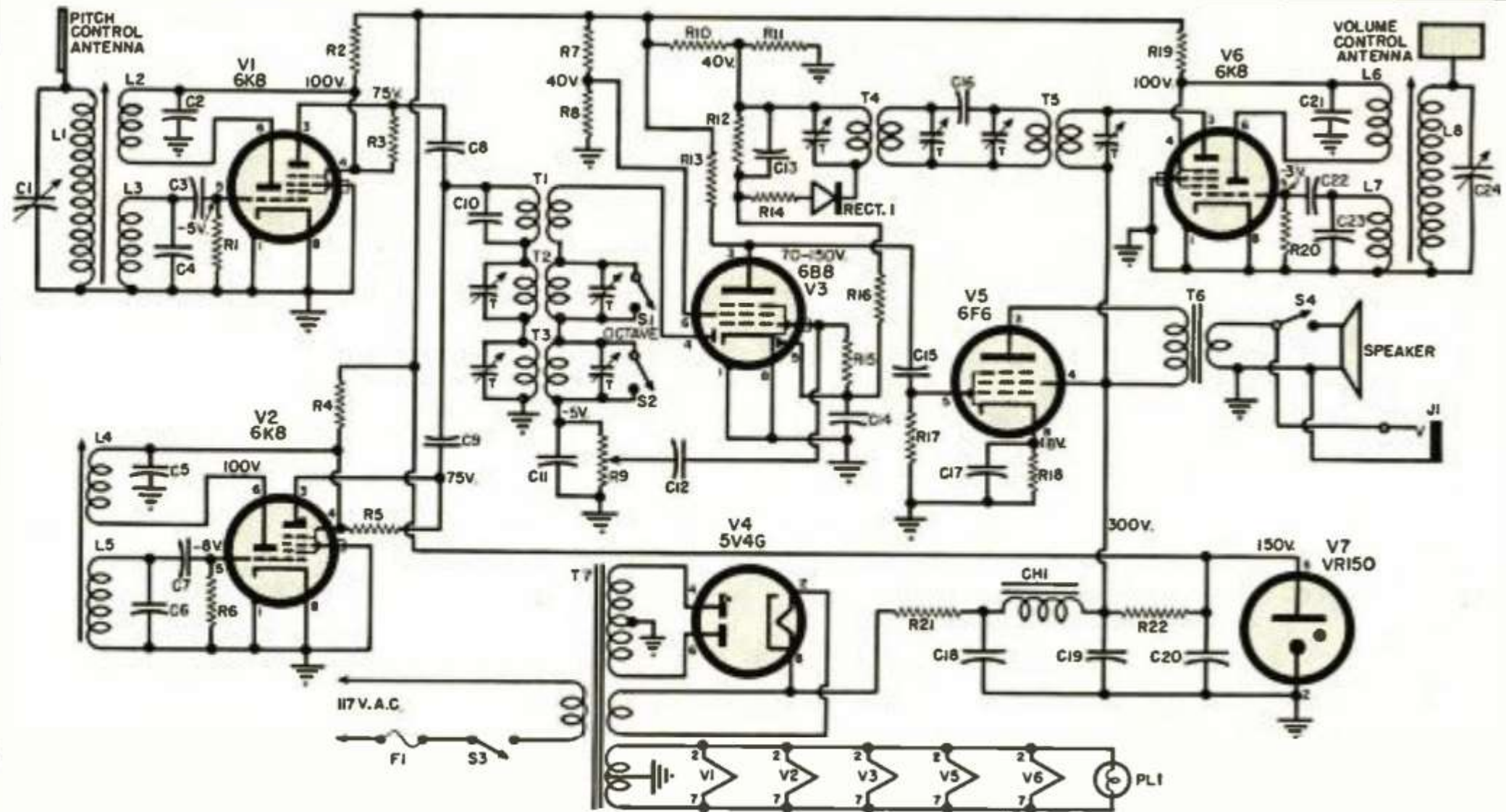


Fig. 1. Over-all view of the home-built Theremin. The cabinet is made of $\frac{1}{2}$ -inch plywood. The speaker panel is constructed of $\frac{1}{4}$ -inch Masonite. The antennas are mounted with through bolts and wing nuts.

Fig. 3. Complete schematic diagram for the Theremin. All voltage readings shown were taken with 20,000 ohms-per-volt meter.



R_1, R_8, R_{13}, R_{20} —100,000 ohm, $\frac{1}{2}$ w. res.
 R_2, R_4, R_{10} —4700 ohm, 1 w. res.
 R_3, R_5, R_{14} —10,000 ohm, $\frac{1}{2}$ w. res.
 R_7, R_{12} —47,000 ohm, $\frac{1}{2}$ w. res.
 R_6 —22,000 ohm, $\frac{1}{2}$ w. res.
 R_{11} —250,000 ohm, 1 w. res.

C_{14}, C_{21} —.05 μ fd., 400 v. cond.
 C_{15} —.01 μ fd., 400 v. cond.
 C_{17} —20 μ fd., 25 v. elec. cond.
 C_{18}, C_{19}, C_{20} —20 μ fd., 450 v. elec. cond.
 C_{22} —.002 μ fd., mica cond.

PL_1 —6.3 volt pilot light
 $Spkr.$ —6" loudspeaker
 $Rect.1$ —1N34 germanium diode
 S_1 —S.p.s.t. switch (second harmonic, octave)
 S_2 —S.p.s.t. switch (third harmonic)

Moog Theremin Kit



CC BY-SA 3.0,
<https://commons.wikimedia.org/w/index.php?curid=408208>

Moog Theremin
Available now
\$479 at Long & McQuade



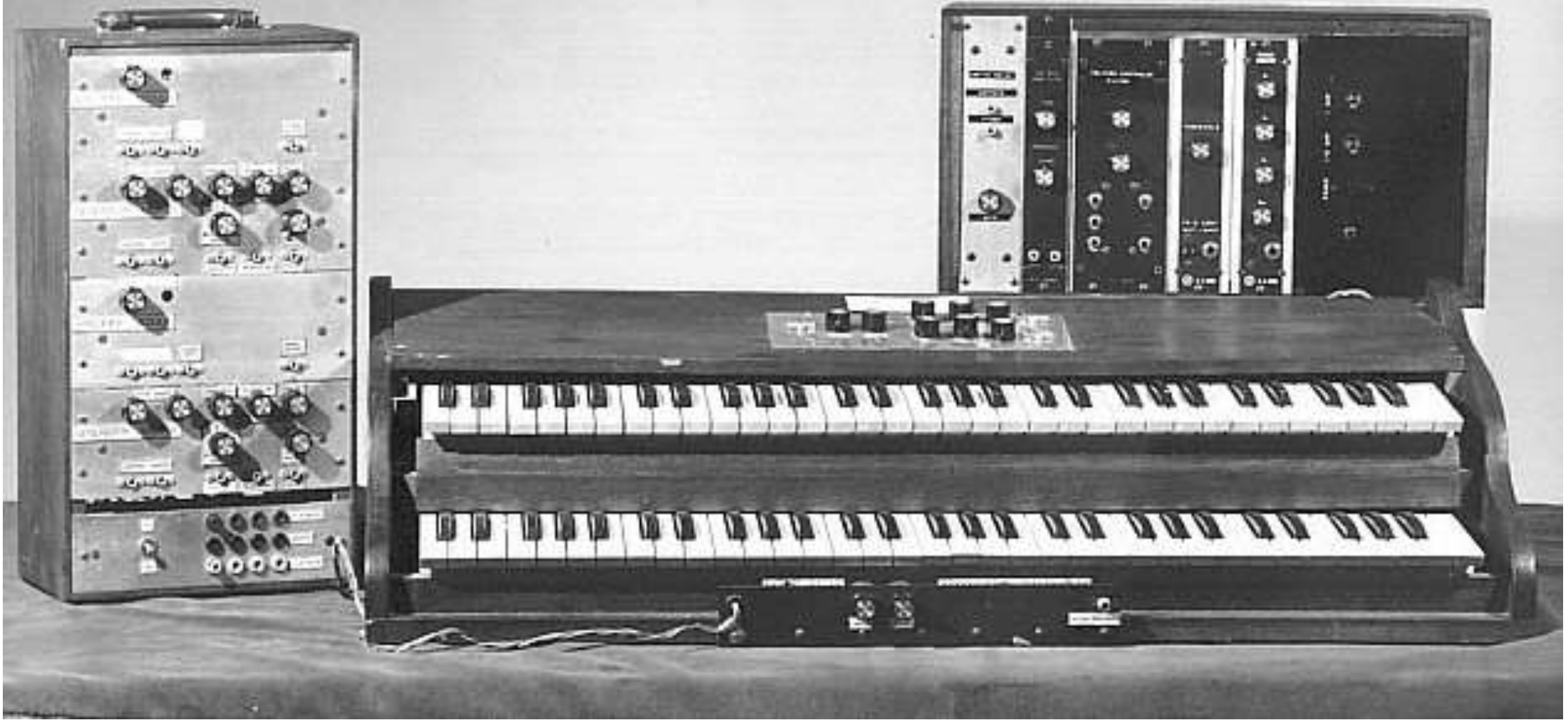
Moog Synthesizer

- Moog's first modular synthesizer, 1964, was "the first widely used electronic music synthesizer and the first instrument to make the crossover from the avant-garde to popular music."
- Over the next decade Moog created numerous keyboard synthesizers, Modular components (many licensed from design by Harald Bode), Vocoder (another Bode design), Bass pedals, Guitar synthesizers and so-on.
- Moog's designs set a standard for future commercial electronic musical instruments.
- Moog, Deutsch, Scott, Bose

End of Moog

- Moog did not patent much of his work. He ran the company like a hobby.
- Despite innovation, the Moog Synthesizer Company did not survive the decade, larger companies such as Arp and Roland developed Moog's prototypes into more sophisticated and cost effective instruments.
- Moog re-acquired the rights to the Moog company name in 2002 and once again began to produce updated versions of the Moog Synthesizer range.

Early Moog Modular Synthesizer 1964









Moog Modules

- sequencer





921 VOLTAGE CONTROLLED OSCILLATOR

The 921 Voltage Controlled Oscillator generates periodic waveforms within a total frequency range from .01 to 40,000 cycles per second. It produces sine, triangle, sawtooth, and rectangular waveforms simultaneously. The frequency of all waveforms and the width of the rectangular waveform are both voltage controllable. Complementary auxiliary outputs and provisions for triggered waveform clamping are included. Typical applications include audio signal generation and control signal generation for modulation of other signals.

- Outstanding frequency stability over a wide ambient temperature range

- Frequency range from .01 to 40,000 hertz

- Fixed level sine, triangle, sawtooth, and variable width rectangular waveforms available simultaneously

- Complementary high level auxiliary output waveforms, switch-selectable, with continuously variable level

- Waveform clamping to a preset point by S and V trigger signals

- Voltage controllable rectangular waveform width

- Compatible with existing Moog modules



903A RANDOM SIGNAL GENERATOR

The 903A Random Signal Generator produces signals of random wave-shape and continuous frequency content. The two outputs provide different energy distributions: equal energy per frequency increment (white noise) and equal energy per octave (pink noise). Typical applications include generation of unpitched sounds, and control signal generation for random effects.

- Full Frequency Random Noise Generation

- White and Pink Noise Energy Distribution



moog

902 VOLTAGE CONTROLLED AMPLIFIER

The 902 Voltage Controlled Amplifier is a signal processing module for amplitude modulation of signals within the frequency range from DC to over 50,000 cycles per second. It permits variable gain up to a factor of 2 (+6 dB), by manual or voltage control, with either linear or exponential gain response to the control signal. It has complementary inputs and outputs, and produces two quadrant multiplication of signals connected to the signal processing and control inputs. Typical applications include amplitude contouring, modulation, and gating of both audio and control signals.

- 80 dB Dynamic Range
- DC to 50,000 Hz Frequency Range, Signal and Control Inputs
- Amplification Factor of 2X
- Complementary Inputs and Outputs
- Linear and Exponential Control Response

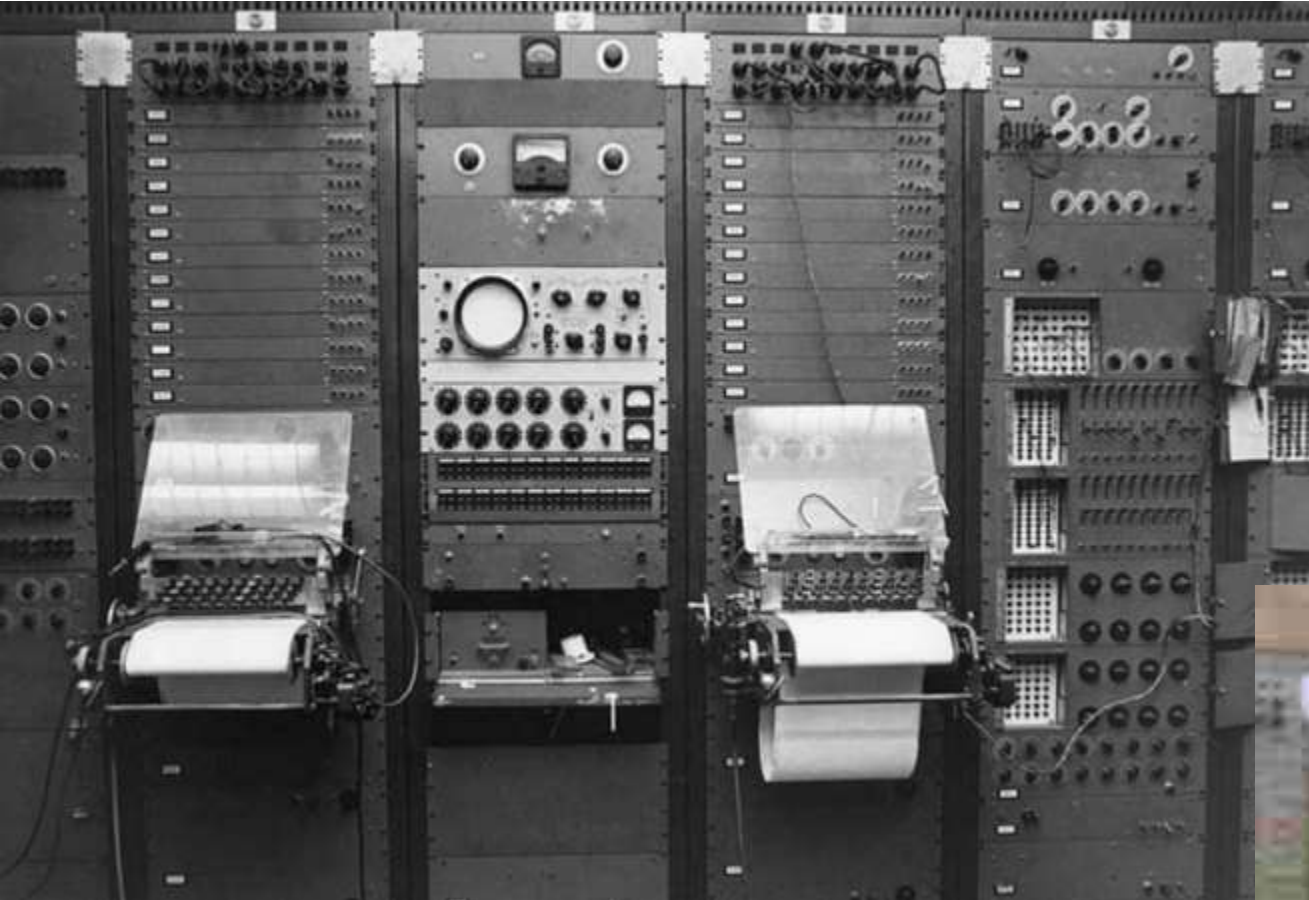


Top Hits from my Misspent Childhood

- Isao Tomita: “Snowflakes are Dancing” 1974.
- “Everything you always wanted to hear on the Moog but were afraid to ask for”
- “Popcorn” (by Hot Butter). “Carmen” (Anarchic System)
- 1975 “Autobahn” (Kraftwerk)
- Wendy Carlos’s album “Switched on Bach” was entirely recorded using Moog synthesisers (and one of the highest-selling classical music recordings of its era), brought the Moog to public attention and changed conceptions about electronic music and synthesisers in general.

RCA Synthesizer

- Predates Moog's work.



RCA Synthesizer. Paper tape driven



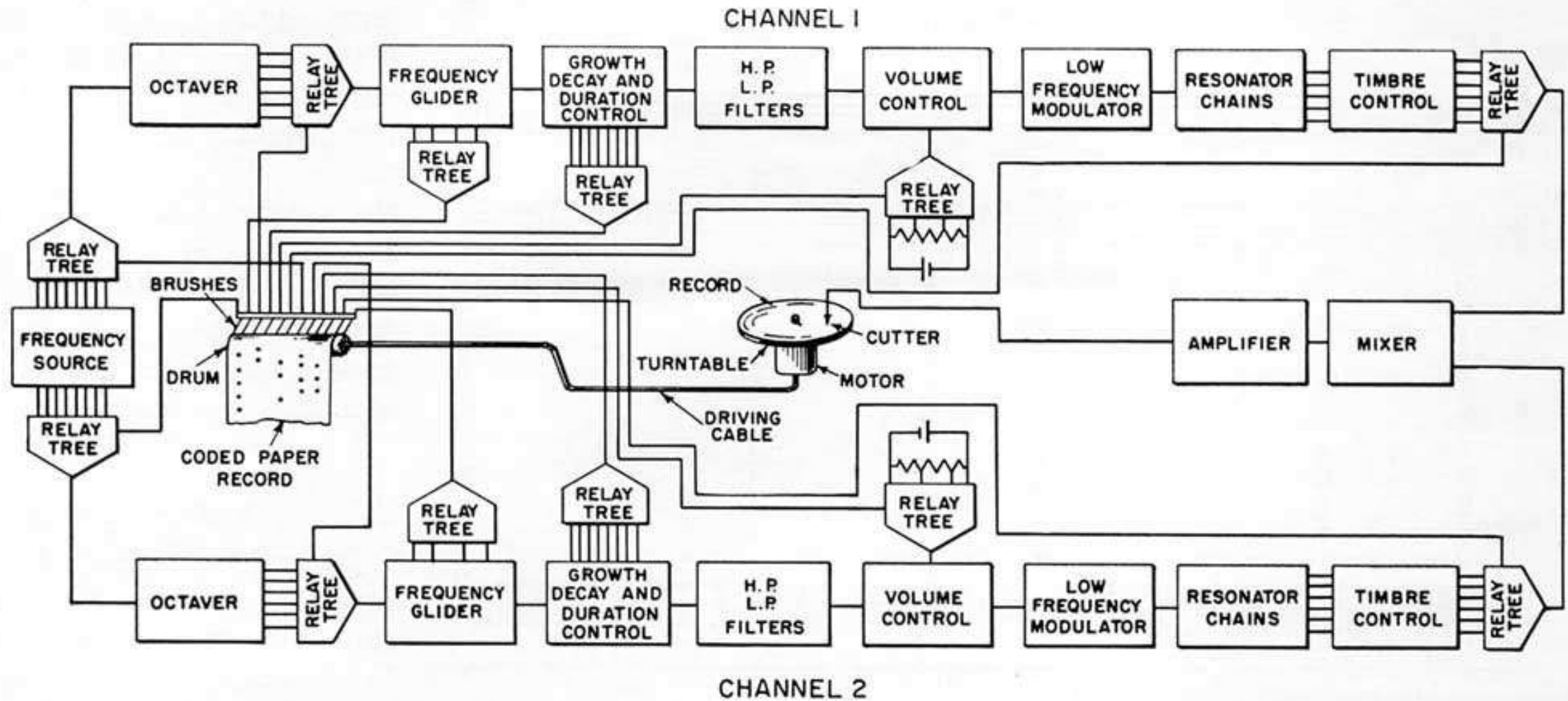


Fig. 6. A schematic diagram of the RCA Electronic Music Synthesizer which provides the facilities for obtaining any and all of the characteristics of a tone, namely, frequency, intensity, growth, steady state, decay, waveform, portamento, duration, vibrato and deviation of any value at any instant

Stylophone

Alain Dufour

Hammond S6 Organ

- Sylvain's collection
- Circa 1958
- Tube oscillators.
- Three “voices”
 - Organ using 16 oscillators
 - Solo using one oscillator ← has more flexibility than the organ
 - Above uses one keyboard
 - Chords & bass pedal using 6 oscillators and button box
- Circuits for vibrato, timbre (attack, sustain, dwell), various voices (controlling harmonics)



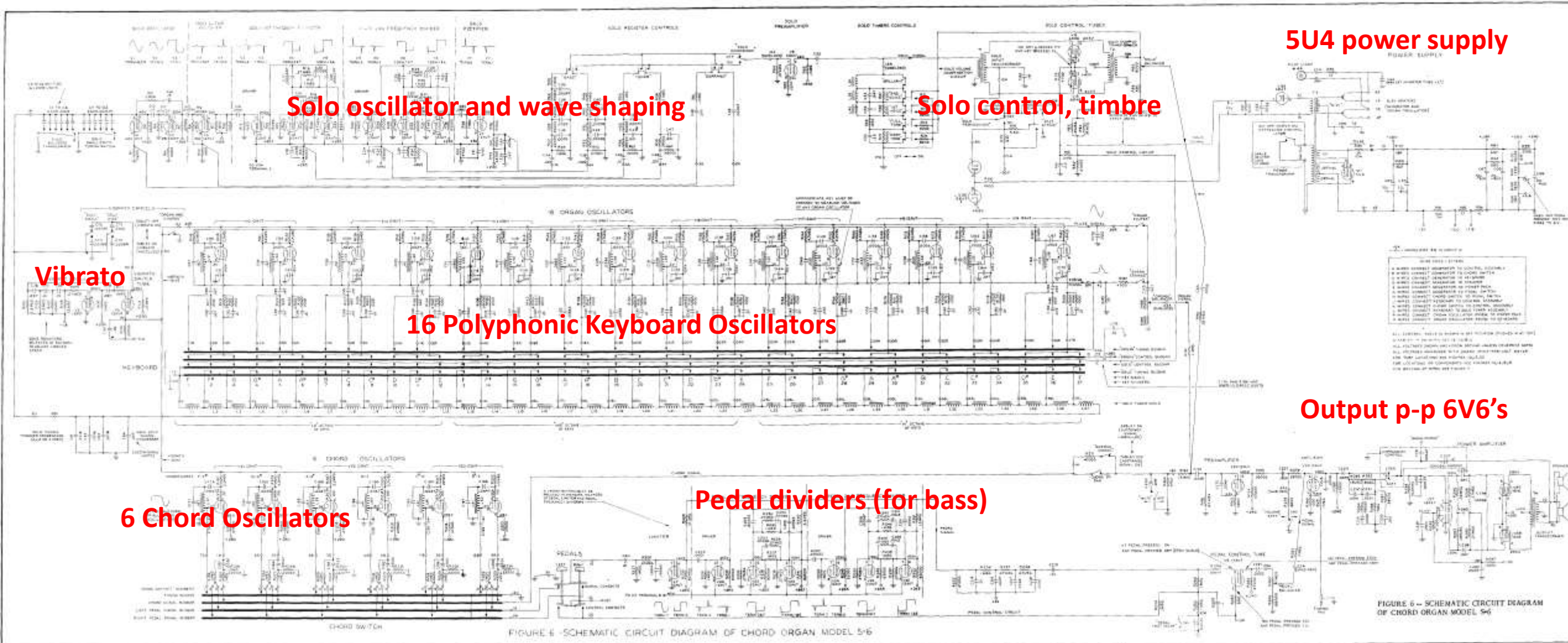


Chords





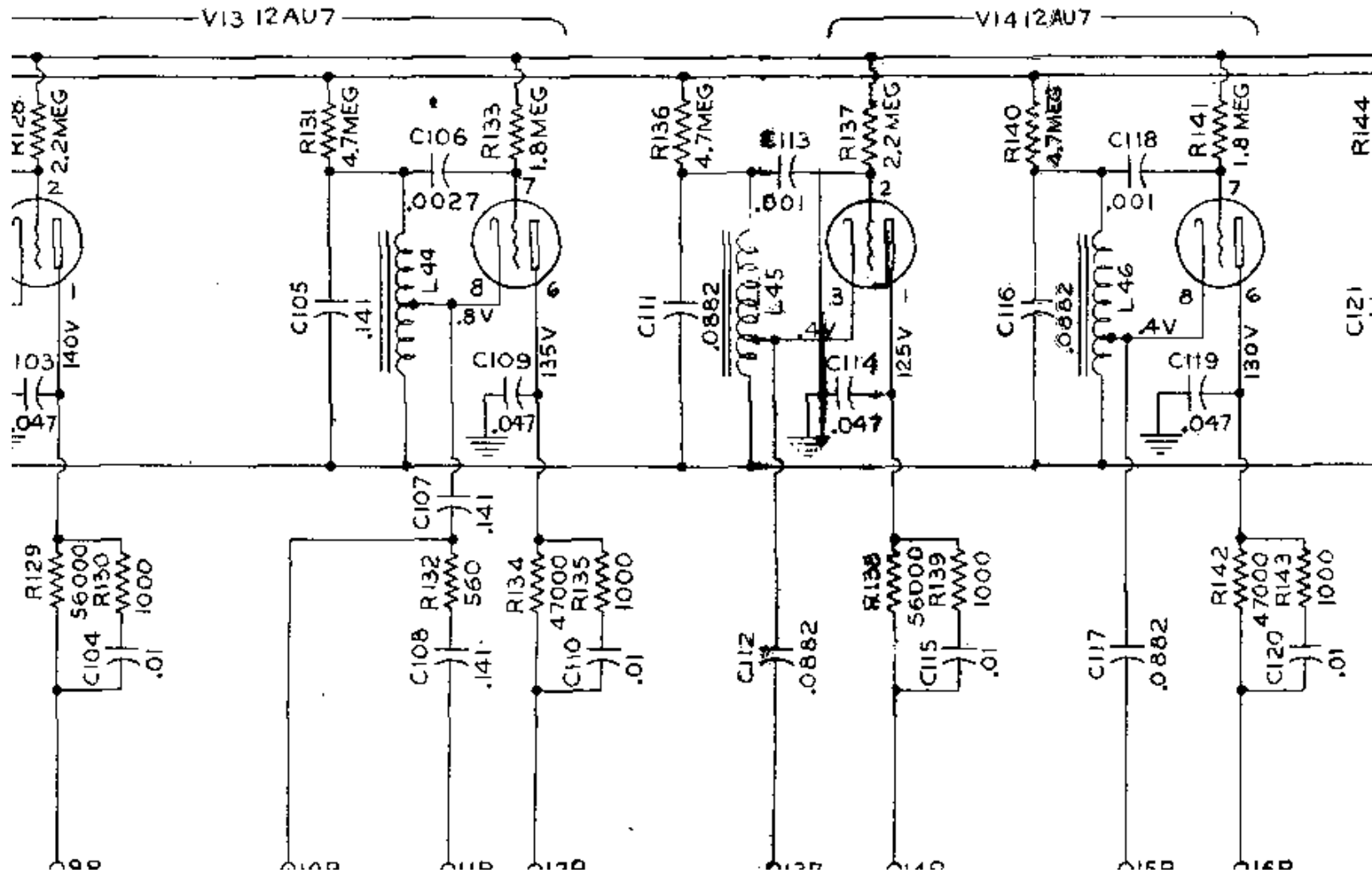
Sylvain's Hammond S6 Organ. 30 Tubes (a lot of dual triodes)



Can do: 6th, 9th, major, minor, 7th, dim, aug, minor 7th. None have notes a half-tone apart.

Sylvain's Hammond S6 Organ. 30 Tubes (a lot of dual triodes)

16 Polyphonic Keyboard Oscillators





Lea's Casio WK-1500

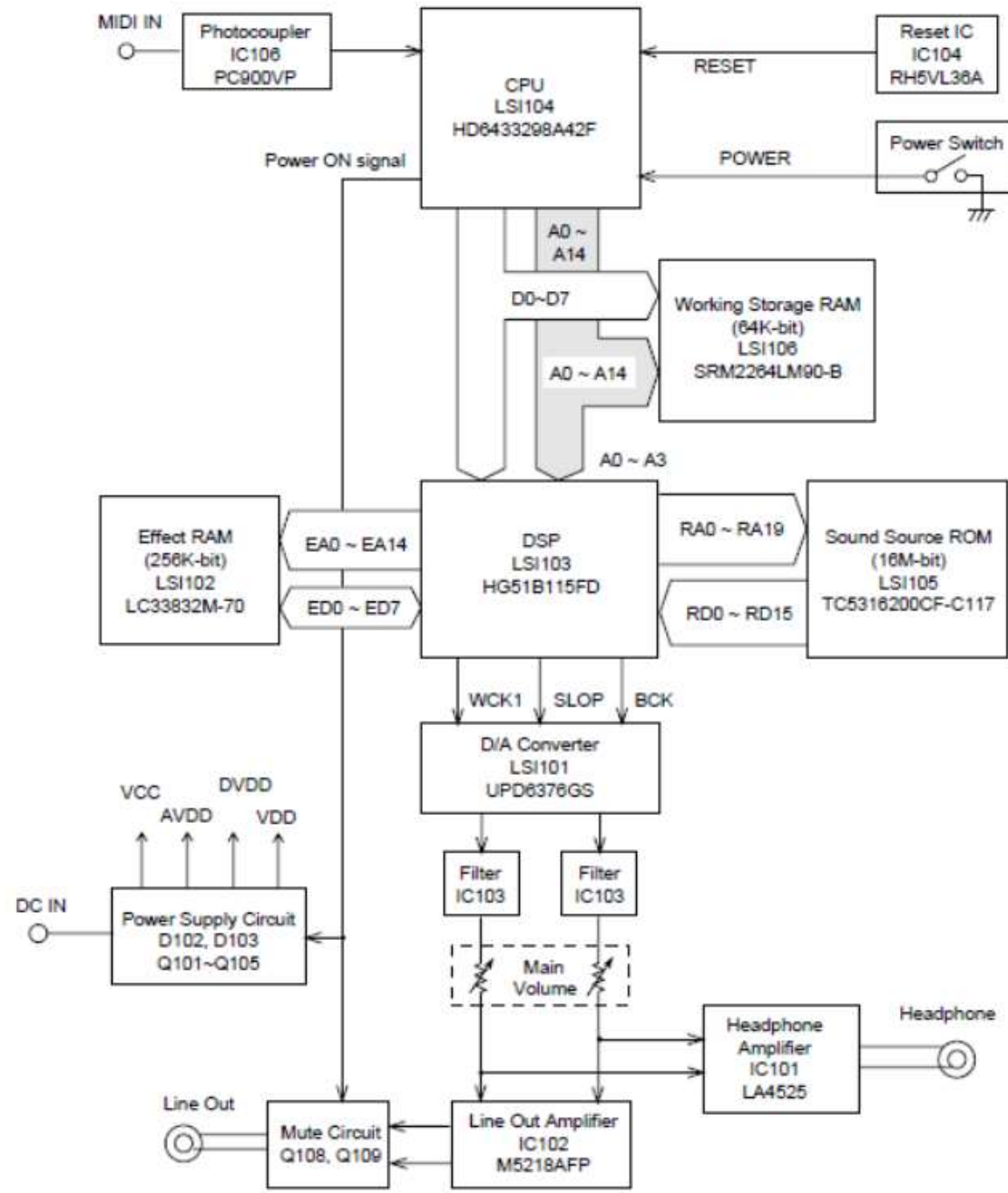
Casio WK-1500 Synthesizer

- Lea's collection
- Circa 1980
- Controlled by a CPU
- Waveforms are stored in ROM
- When CP Air (remember them?) lost Lea's baggage in a 1980 trip to Buenos Aires, he ended up with a \$700 reimbursement, which he spent on this Casio at Steve's music.
- BTW: his luggage arrived a month later...It had been sitting at the airport in Rome for four months! CP told him to keep the \$700 for aggravation...

Casio WK-1500 Synthesizer

- It is all run by a CPU that interfaces with the keyboard and switches. The CPU controls the Digital Signal Processor (DSP), where the waveforms are generated, and they are then sent to the converters (DAC) and the power amplifier. Most of the musical magic happens in the DSP, and is hidden. It is, however, a digital process, with the waveforms stored in ROM.
- That's a complicated schematic! Here is a simplified block diagram (of a related device).
- However, by today's standards, it's pretty simple.

BLOCK DIAGRAM



Lea Barker plays Elevator Music

Casio WK-1500
keyboard

October, 2007

Background: Chateau Laurier
elevator lobby



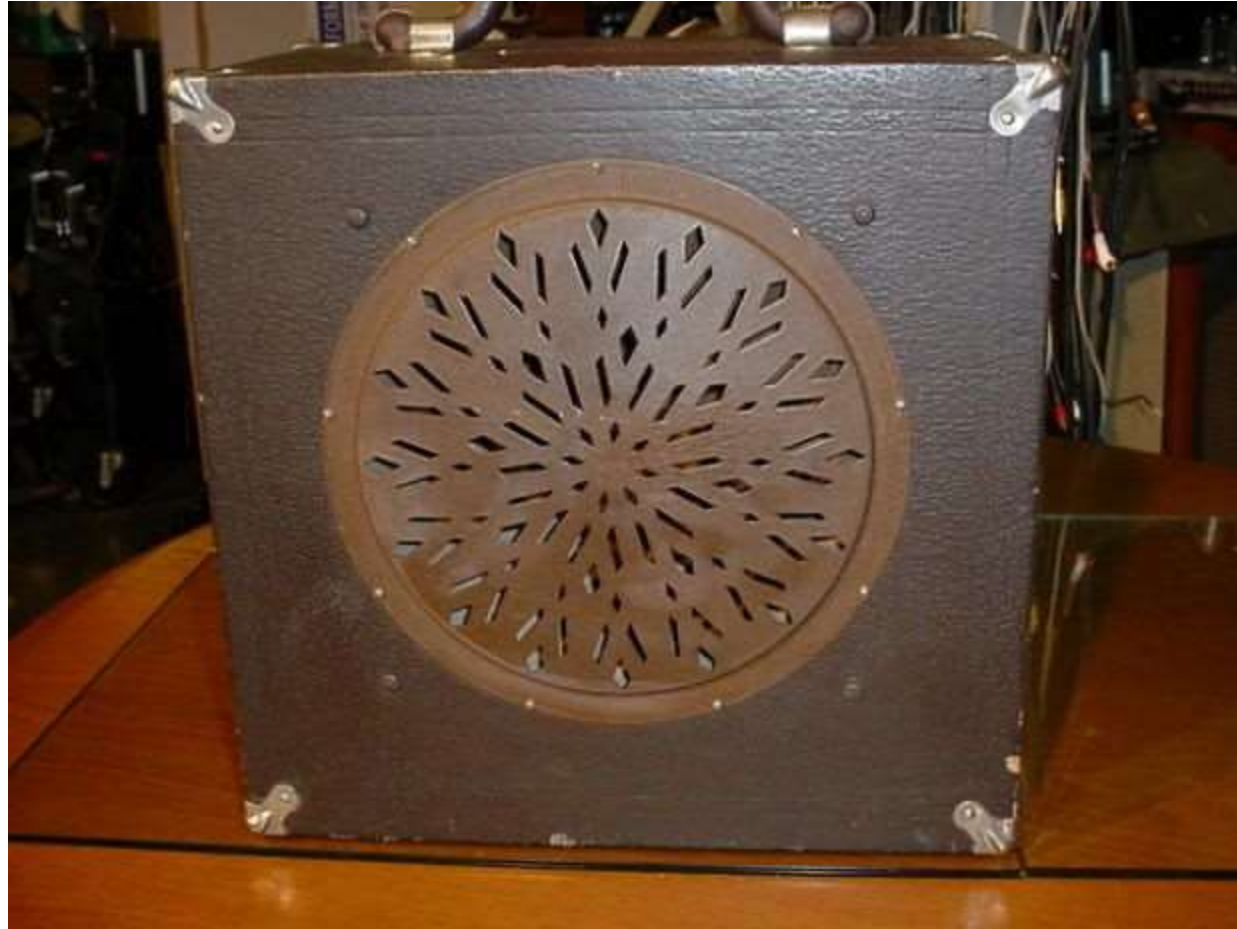
Guitar Amplifiers

Guitar Amplifiers

- Guitar amplifiers are not *merely* amplifiers. A guitar and its amplifier make up a musical instrument. The amplifier lends as much character to the sound as the guitar does.
- Stratovarius did not try to optimize his violins to produce a pure sine wave!
- Guitar amplifiers are intended to be driven to clipping. They have character, like distortion, droop, harmonics, raspiness.
- Blues and Rock guitar sound was defined by the tube amplifier, and most will agree that solid-state amplifiers never sound the same. (You can argue better or worse, but not the same)

Guitar Amplifiers

- The best overview article available anywhere on guitar amplifiers is in our own OVRC newsletter, Winter 1993 & Spring 1994 by (the late) Don Corbett
- JP Tourigny has a 1965 Fender guitar amplifier, and a 1957 electric guitar to share with us.



Dobro Guitar amp, C 1935, 2A3





National 6515



Gibson E150, mid
Predates EH150



Gibson EH150. Circa 1940. Very early guitar amplifier

THE EH-150 AMPLIFIER

A masterpiece in electrical tone reproduction—strongly made of the finest materials money can buy to give faithful reproduction from other boxes—an all-purpose amplifier that will take two instruments, a microphone and an extra speaker.

7 tubes with tremendous reserve power which guarantees maximum volume with ease and no distortion. 4 strong amplifiers with silver mesh output, uncolored. Amplifier has high gain so that it can be used successfully with any type of microphone.

A new 12" Ultrasonic High Fidelity speaker especially de-

signed for this unit—the voice coil is sealed to prevent any dirt from getting in and causing distortion.

New design case, covered with waterproof Acrylone cloth, strong luggage catches and leather handles, easy grip handle. Removable back. Waterproof slip cover to protect amplifier from weather.

12 foot instrument cord—exceptionally strong and shielded. Heavy nickel plated shielded plugs and spring connectors. 10 foot shielded amplifier cord.

Size—18½" wide, 18½" high and 8½" deep.

CONTROL PANEL EQUIPMENT

From left to right

1. On-off switch; 2. Reversible bass; 3. Extra speaker socket; 4. Control dial for microphone; 5. New ruby light on-off indicator; 6. Control dial for instruments; 7. Socket for microphone; 8. Sockets for two instruments; 9. Volume instrument socket; Bass or Manual tone control.

FOR AC-DC CURRENT

EH-150 MODEL—Same as EH-150 model but with special unit to be used with either AC or DC current. See price in right of regular AC unit.

PRICES

	AC	AC-DC
Complete 4 string outfit—Instrument, Case, Amplifier and Cords	\$142.00	\$155.00
Complete 3 string outfit—Instrument, Case, Amplifier and Cords	115.00	125.00
4 string instrument only, with cords	15.00	15.00
3 string instrument only, with cords	12.00	12.00
Amplifier only	75.00	75.00
Instrument case	12.00	12.00

[35]





Fender champion
1953

Probably \$50 at the time
Influential for blues music



Fender Bassman



Fender Bassman

Epilogue

- In 1965, Fender was sold to CBS.
- Amplifiers were redesigned to make them “better” and more reliable.
- This caused outrage from the community of guitarists who had come to appreciate existing amplifiers, and Fender was never quite the same.
- Later, changes were reversed, but the damage had been done.