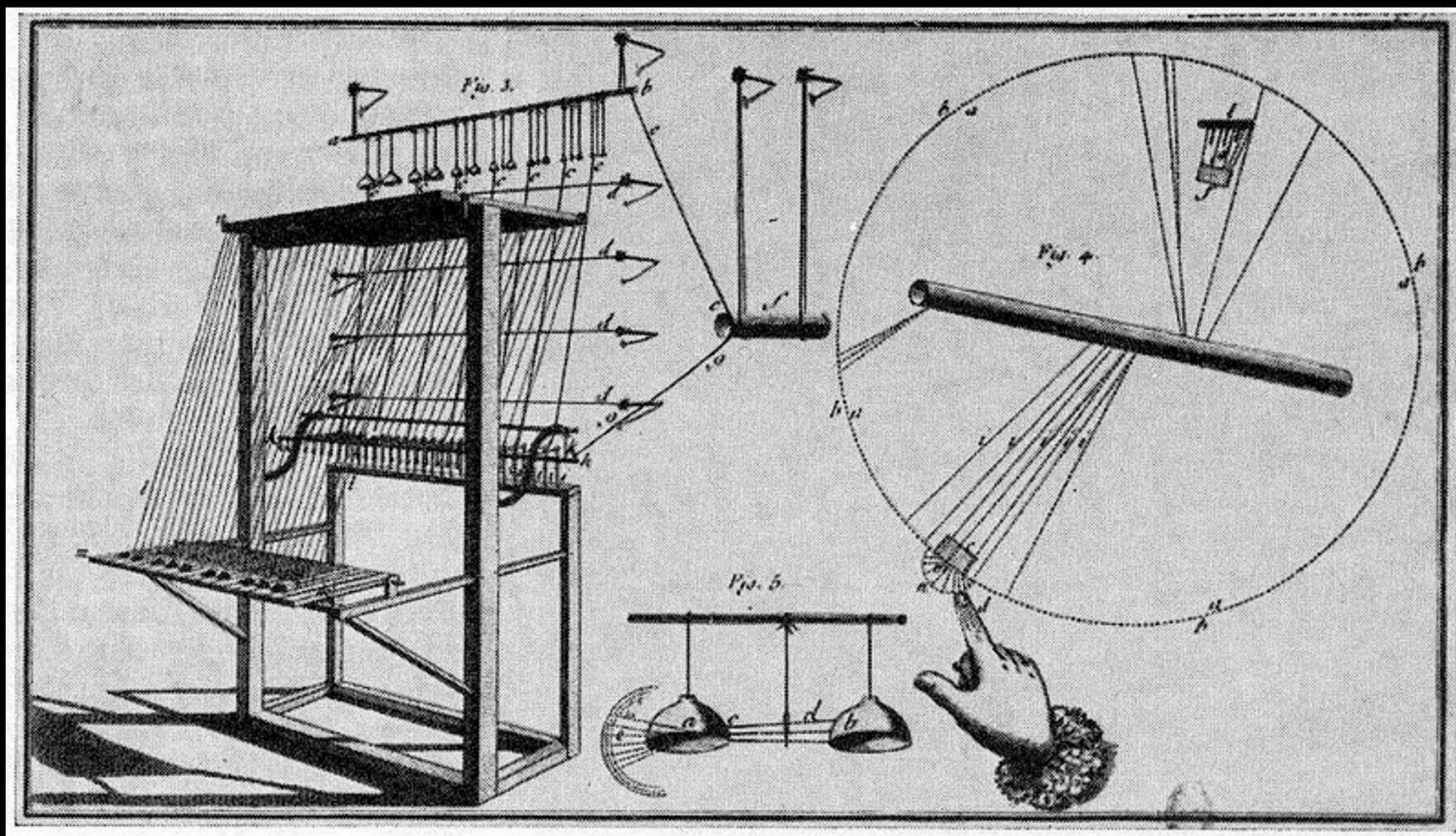
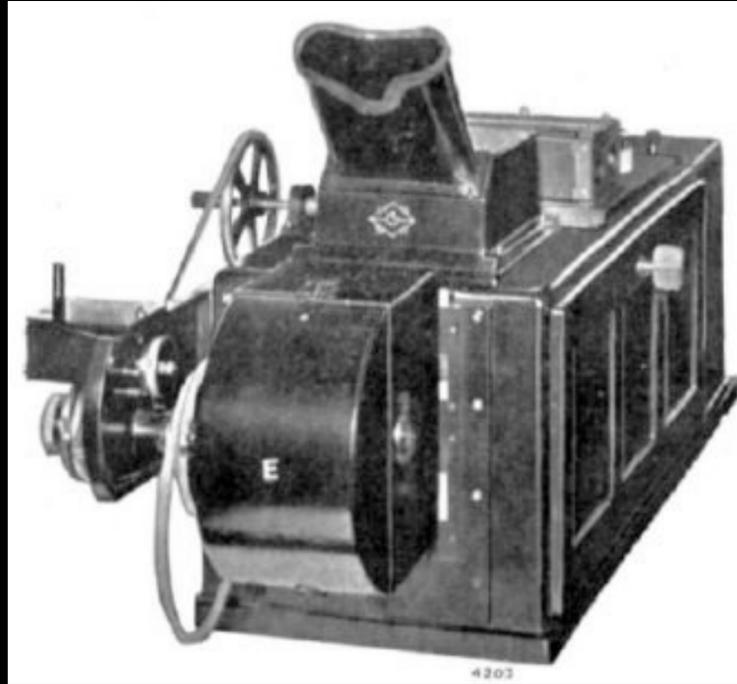
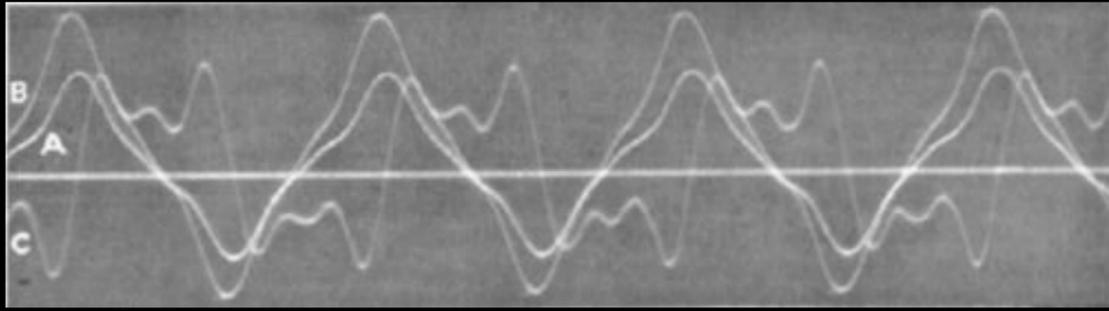


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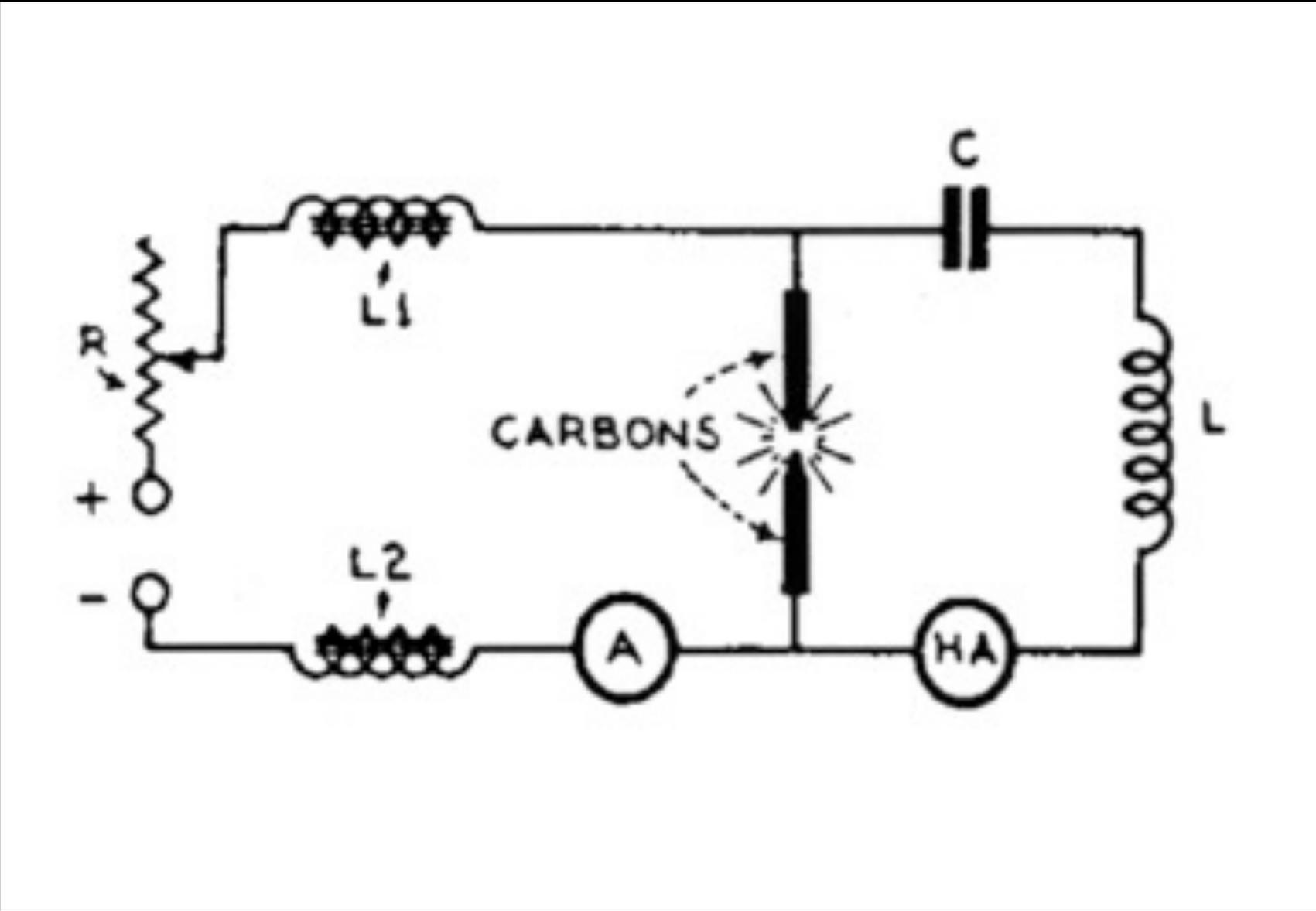


1761 - "The Electric Harpsicord" - instrumental aspect of electronic music. Does not always include the more esoteric and philosophical nature of the form - sometimes it's about new timbres, expediency (like the organ in radio soundtracks, etc.) and other cultural shifts (attention to space in the 60's).

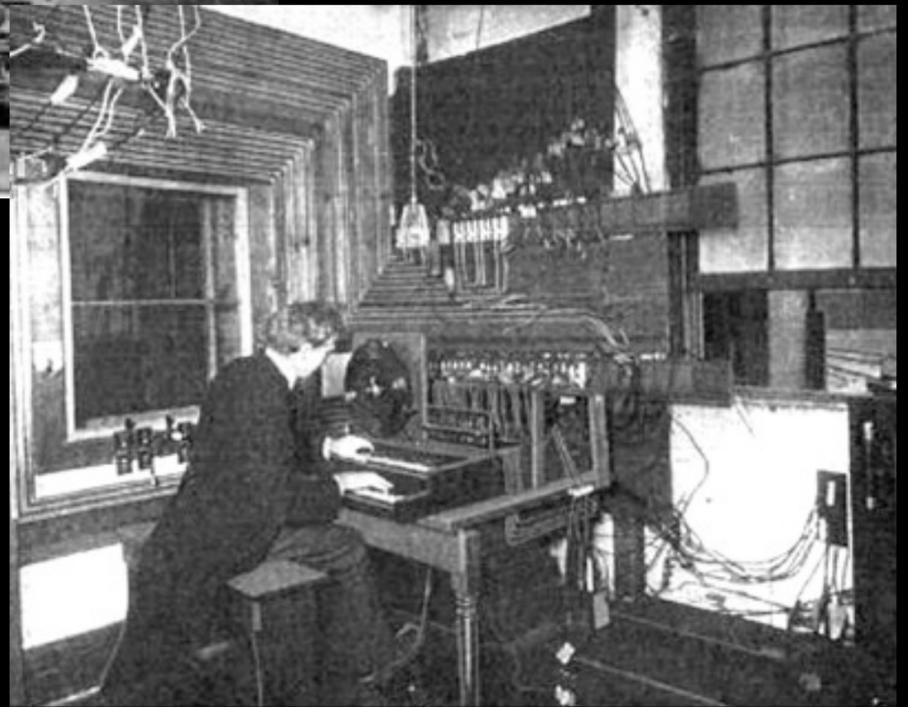
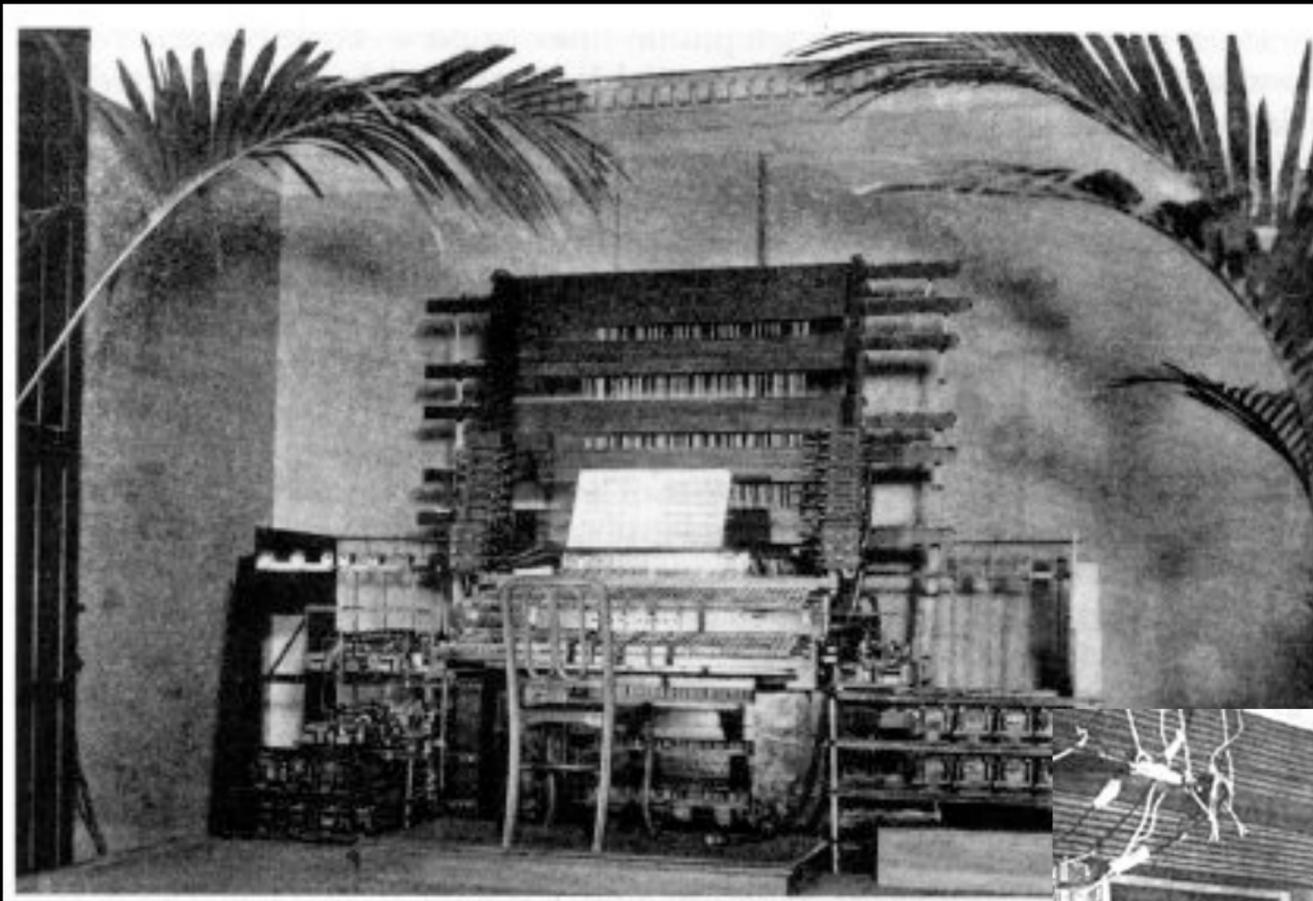


"Galvanic music" 1837

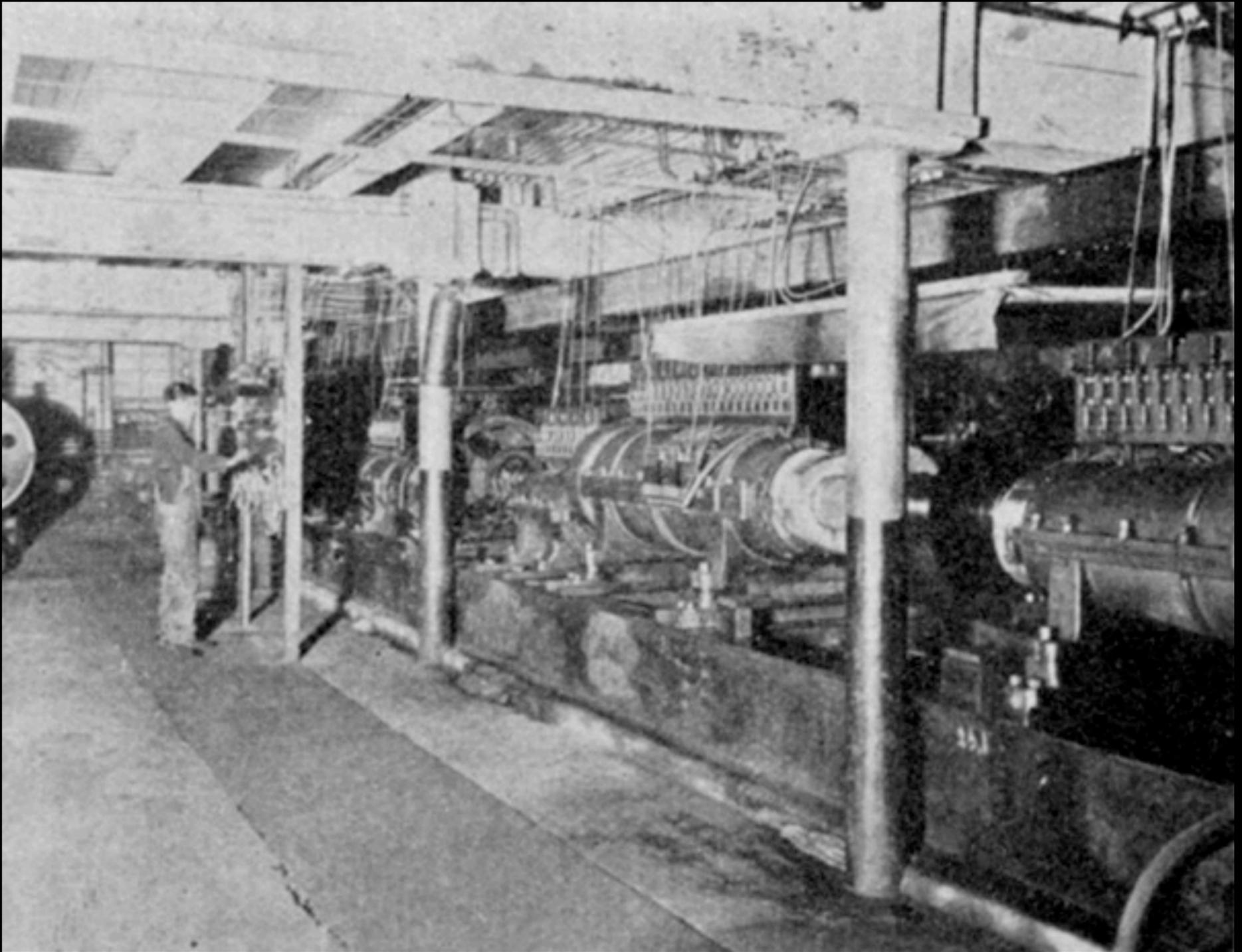
Dr. Page, Salem Mass., purely electrical sound generation:
coils close to magnets induce a tone related to the number of turns in the coils

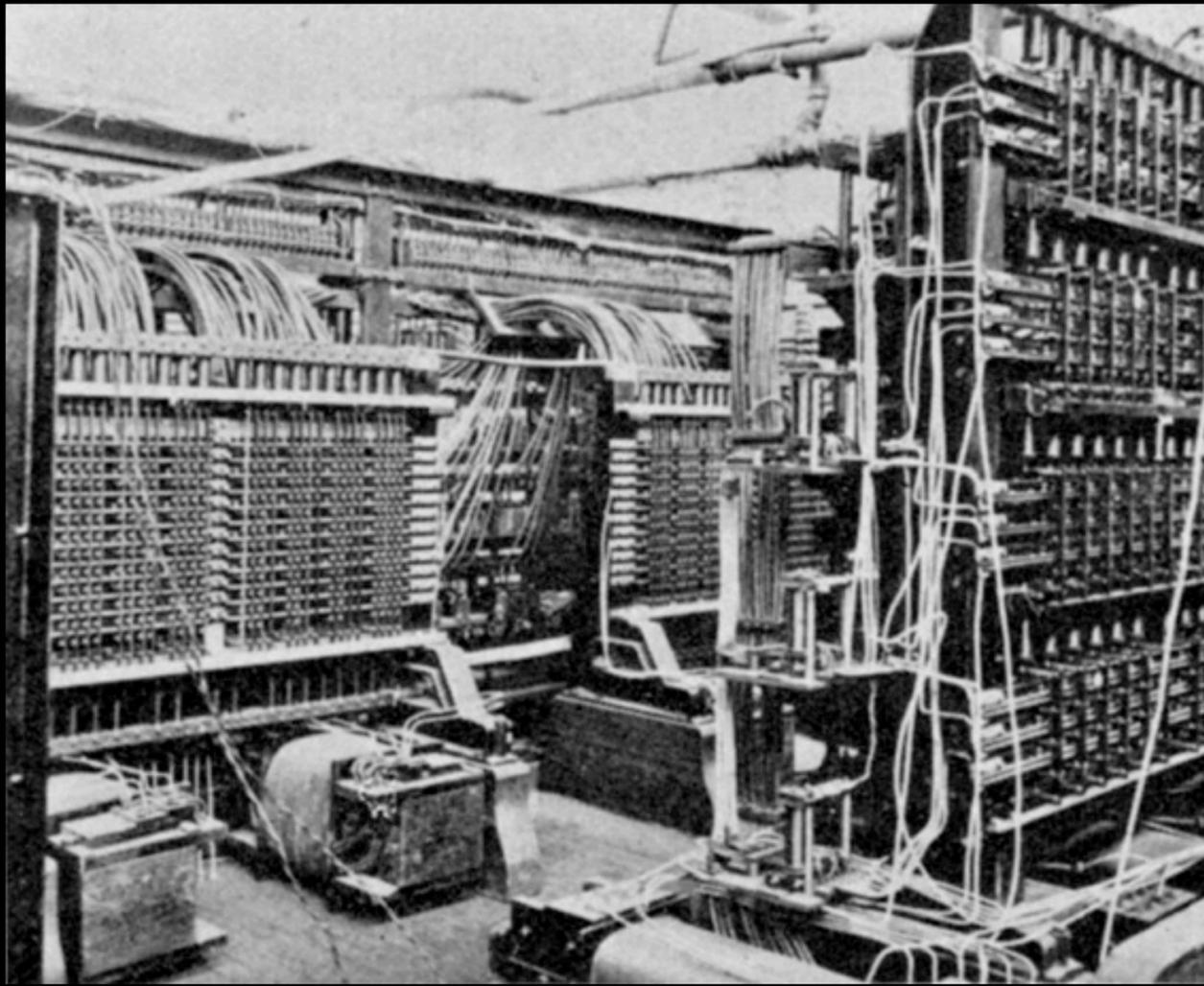


"Singing arc" 1899 William Dudel, carbon arc whistles modulated with an electrical coil & capacitor. A keyboard was added later.



"Telharmonium" 1906 Thaddeus Cahill, New York
Large (several box cars, 200 tons in weight) instrument using large spinning turbines; specifically cogged wheels that induced a frequency related to the number of poles and the speed. Each turbine had an integer multiple of the cogs on it so each harmonic was available for mixing to create the different timbres. Since there was no means as yet for electrical amplification, the individual turbines (there was 5 octaves worth driven by a 200 hp motor) were mixed in large iron core transformers. The instrument was controlled by a thirty-six note per octave keyboard which was difficult for one performer to play. The sound was distributed to subscribers over the phone system.



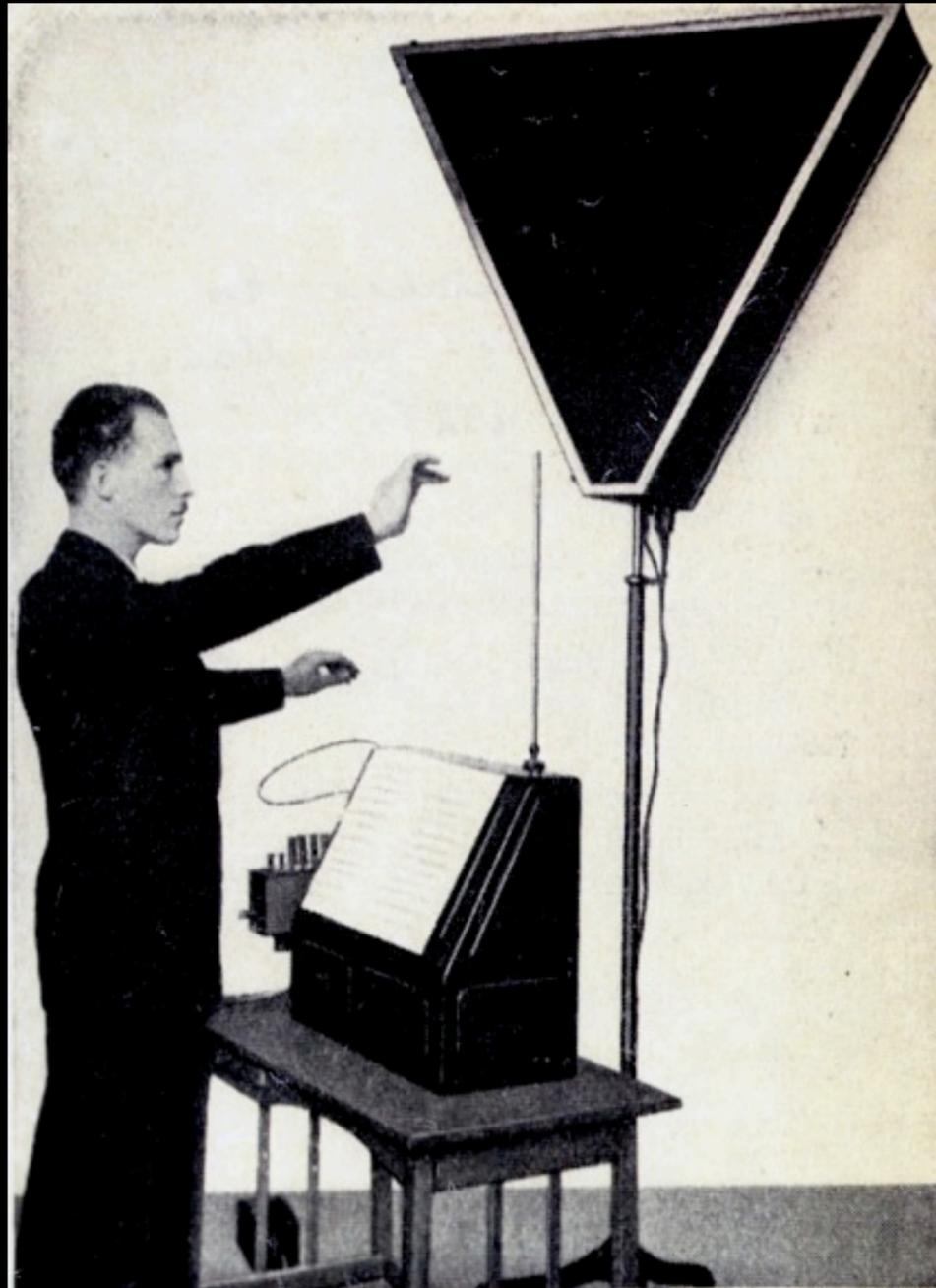


SCIENTIFIC AMERICAN

NO. 1000. NEW YORK, WEDNESDAY, 1890. PRICE 10 CENTS.



THE MANUFACTURE OF SHEET-IRON FOR THE SCIENTIFIC AMERICAN AND PUBLICATION OF BOSTON. 1890-1891.



"Theremin"

1919

Leo Theremin, Soviet Union

A device with two sensors or antenna: One for amplitude and the other for pitch



Léon Theremin (born Lev Sergeevich Termen;Russian: Лёв Сергеевич Термён) (27 August [O.S. 15 August] 1896 – 3 November 1993) was a Russian and Soviet inventor. He is most famous for his invention of the theremin, one of the first electronic musical instruments.



After being sent on a lengthy tour of Europe starting 1927 – including London, Paris and towns in Germany – during which he demonstrated his invention to full audiences, Theremin found his way to the United States, arriving December 30, 1927 with his first wife Katia.[20] He performed the theremin with the New York Philharmonic in 1928. He patented his invention in the United States in 1928 and subsequently granted commercial production rights to RCA.

Theremin set up a laboratory in New York in the 1930s, where he developed the theremin and experimented with other electronic musical instruments and other inventions. These included the Rhythmicon, commissioned by the American composer and theorist Henry Cowell. In 1930, ten thereminists performed on stage at Carnegie Hall. Two years later, Theremin conducted the first-ever electronic orchestra, featuring the theremin and other electronic instruments including a "fingerboard" theremin which resembled a cello in use.



Raymond Scott (born Harry Warnow, 10 September 1908 – 8 February 1994) was an American composer, band leader, pianist, engineer, recording studio maverick, and electronic instrument inventor.

RAYMOND SCOTT CLAVIVOX

CAN SOUND 'SOMETHING' LIKE:

- A VOCALIST, NOT A VOICE
- A CLARINETIST, NOT A CLARINET
- A TROMBONIST, NOT A TROMBONE
- A VIOLINIST, NOT A VIOLIN
- ETC., ETC.
- PLUS A GREAT VARIETY OF SPECIAL EFFECTS, GROWLS, SWOOPS, BRASS LIKE SCREAMS



THE NEWEST ELECTRONIC MUSIC INSTRUMENT— SOUNDS LIKE A HUMAN PERFORMANCE

THE FIRST KEYBOARD INSTRUMENT ON WHICH IT IS POSSIBLE TO SLIDE IN PITCH, AT A CONTROLLABLE RATE, FROM ANY NOTE TO ANY OTHER, WITHOUT THE USE OF ADDITIONAL CONTROLS.

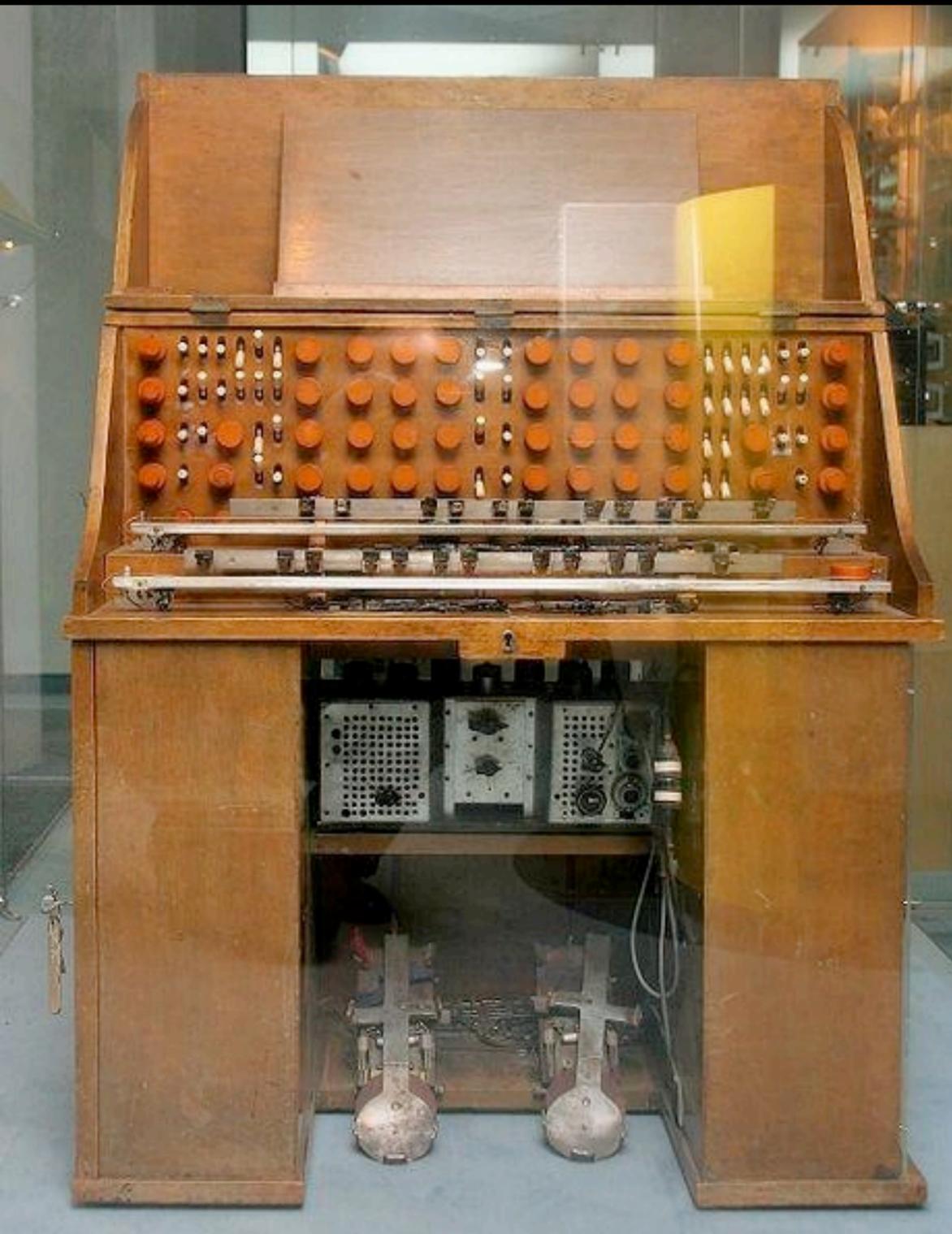
VISIT FARMINGDALE FOR AN IN-PERSON DEMONSTRATION. CONTACT PRISCILLA JONES AT 516-293-8888 OR WRITE

RAYMOND SCOTT ENTERPRISES
3 WILLOW PARK CENTER, FARMINGDALE, N. Y.

RAYMOND SCOTT CLAVIVOX

Scott, who attended Brooklyn Technical High School, was an early electronic music pioneer and adventurous sound engineer. During the 1930s and 1940s, many of his band's recording sessions found the bandleader in the control room, monitoring and adjusting the acoustics, often by revolutionary means. As Gert-Jan Blom & Jeff Winner wrote, "Scott sought to master all aspects of sound capture and manipulation. His special interest in the technical aspects of recording, combined with the state-of-the-art facilities at his disposal, provided him with enormous hands-on experience as an engineer.

In 1946, Scott established Manhattan Research, a division of Raymond Scott Enterprises, Incorporated, which he announced would "design and manufacture electronic music devices and systems." As well as designing audio devices for his own personal use, Manhattan Research Inc. provided customers with sales & service for a variety of devices "for the creation of electronic music and musique concrete" including components such as ring modulators, wave, tone and envelope shapers, modulators and filters. Of unique interest were instruments like the "Keyboard theremin," "Chromatic electronic drum generators," and "Circle generators." Scott often described Manhattan Research Inc. as "More than a think factory – a dream center where the excitement of tomorrow is made available today." Bob Moog, developer of the Moog Synthesizer, met Scott in the 1950s, designed circuits for him in the 1960s, and acknowledged him as an important influence.



The trautionium is a monophonic electronic musical instrument invented about 1929 by Friedrich Trautwein in Berlin at the Musikhochschule's music and radio lab, the Rundfunkversuchsstelle. Soon Oskar Sala joined him, continuing development until Sala's death in 2002. Instead of a keyboard, its manual is made of a resistor wire over a metal plate which is pressed to create a sound. Expressive playing was possible with this wire by gliding on it, creating vibrato with small movements. Volume was controlled by the pressure of the finger on the wire and board. The first Trautioniums were marketed by Telefunken from 1933–35 (200 were made). (Featured in the Alfred Hitchcock film "The Birds" 1962).



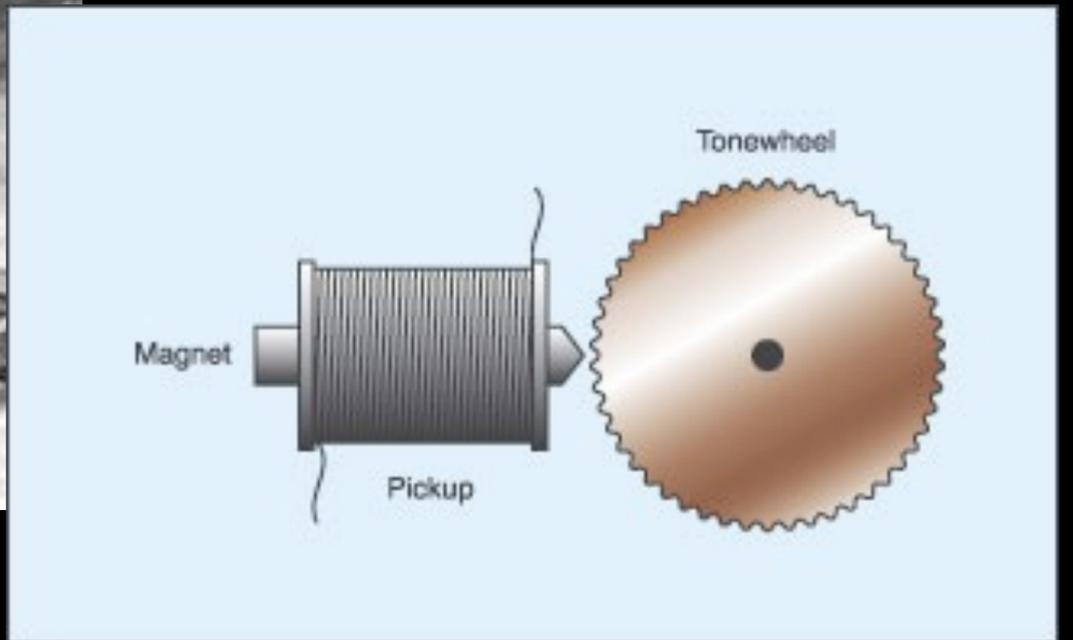
("Martenot waves"), also known as the ondiium Martenot, Martenot and ondes musicales, is an early electronic musical instrument invented in 1928 by Maurice Martenot. The original design was similar in sound to the theremin. The sonic capabilities of the instrument were later expanded by the addition of timbral controls and switchable loudspeakers. The instrument's eerie wavering notes are produced by varying the frequency of oscillation in vacuum tubes. The production of the instrument stopped in 1988, but several conservatories in France still teach it as does the University of Montreal.



The ondes, in its later forms, can be controlled either by depressing keys on the six-octave keyboard (au clavier), or by sliding a metal ring worn on the right-hand index finger in front of the keyboard (au ruban). The position of the ring corresponds in pitch to the horizontal location along the keyboard. The latter playing method allows for unbroken, sweeping glissandi to be produced in much the same manner as a Theremin. The keyboard itself has a lateral range of movement of several millimeters, permitting vibrati of nearly a semitone below or above the pitch of the depressed key to be produced.

By depressing keys or moving the ring, no sound is initially produced. A control operated by the left hand and situated in a small drawer of controls (tiroir) on the left side of the instrument controls the musical dynamics, from silence to fortissimo. This control (touche d'intensité) is glass and lozenge-shaped, and can be depressed several centimetres. The depth to which this key is depressed determines the dynamic level: the deeper, the louder. The manner in which it is pressed determines the attack of the note: quick taps produce staccato articulations, whilst more controlled and deliberate depressions are used to play legato.

The small drawer of controls also contains flip-switches to control the instrument's timbre. These function in much the same way as a pipe organ's stops can be added or removed. Like organ stops, each switch has its own sound color which can be added to the chorus of other timbres.



The Hammond organ is an electric organ invented by Laurens Hammond in 1934 and manufactured by the Hammond Organ Company. While the Hammond organ was originally sold to churches as a lower-cost alternative to the wind-driven pipe organ, in the 1960s and 1970s it became a standard keyboard instrument for jazz, blues, rock music, church and gospel music.

The original Hammond organ used additive synthesis of waveforms from harmonic series made by mechanical tonewheels that rotate in front of electromagnetic pickups. The component waveform ratios are mixed by sliding drawbars mounted above the two keyboards. Although many different models of Hammond organs were produced, the Hammond B-3 organ is most well known. In the late 1960s and throughout the 1970s the distinctive sound of the B-3 organ (often played through a Leslie speaker) was widely used in Blues, progressive rock bands and blues-rock groups. The last electromechanical Hammond organ came off the assembly line in the mid-1970s.



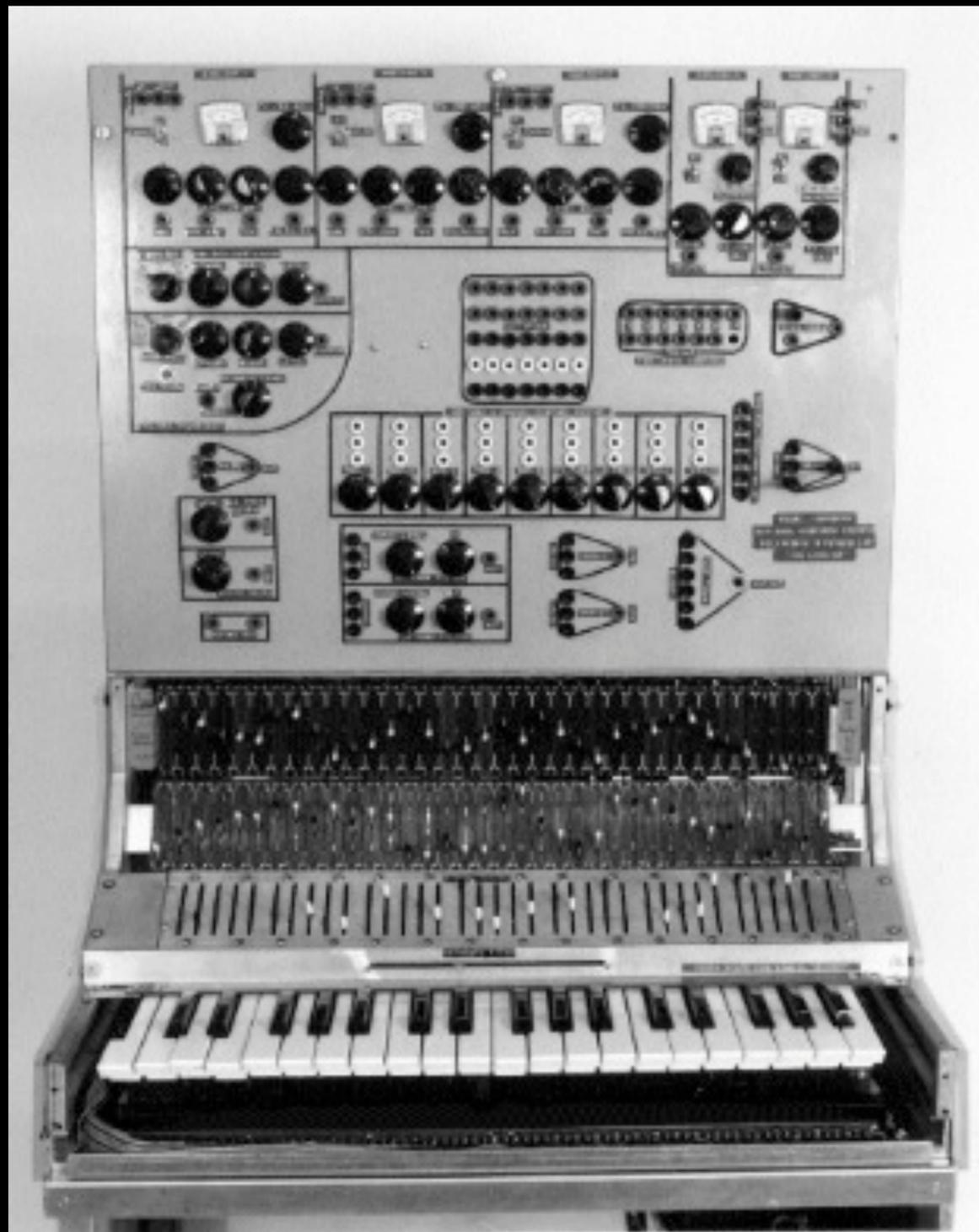
The Novachord is often considered to be the world's first commercial polyphonic synthesizer. All-electronic, incorporating many circuit and control elements found in modern synths, and using subtractive synthesis to generate tones, it was designed by John M. Hanert, Laurens Hammond and C. N. Williams and manufactured by the Hammond company. Only some 1069 examples were built over a period from 1939 to 1942. It was one of very few electronic products released by Hammond that was not intended to emulate the sound of an organ.



Hugh Le Caine (May 27, 1914 – July 3, 1977) was a Canadian physicist, composer, and instrument builder. Le Caine was brought up in Port Arthur (now Thunder Bay) in northwestern Ontario. After completing his Master of Science degree from Queen's University in 1939, Le Caine was awarded a National Research Council of Canada (NRC) fellowship to continue his work on atomic physics measuring devices at Queen's. He worked with the NRC in Ottawa from 1940 to 1974. During World War II, he assisted in the development of the first radar systems. On an NRC grant he studied nuclear physics from 1948 to 1952 in England.



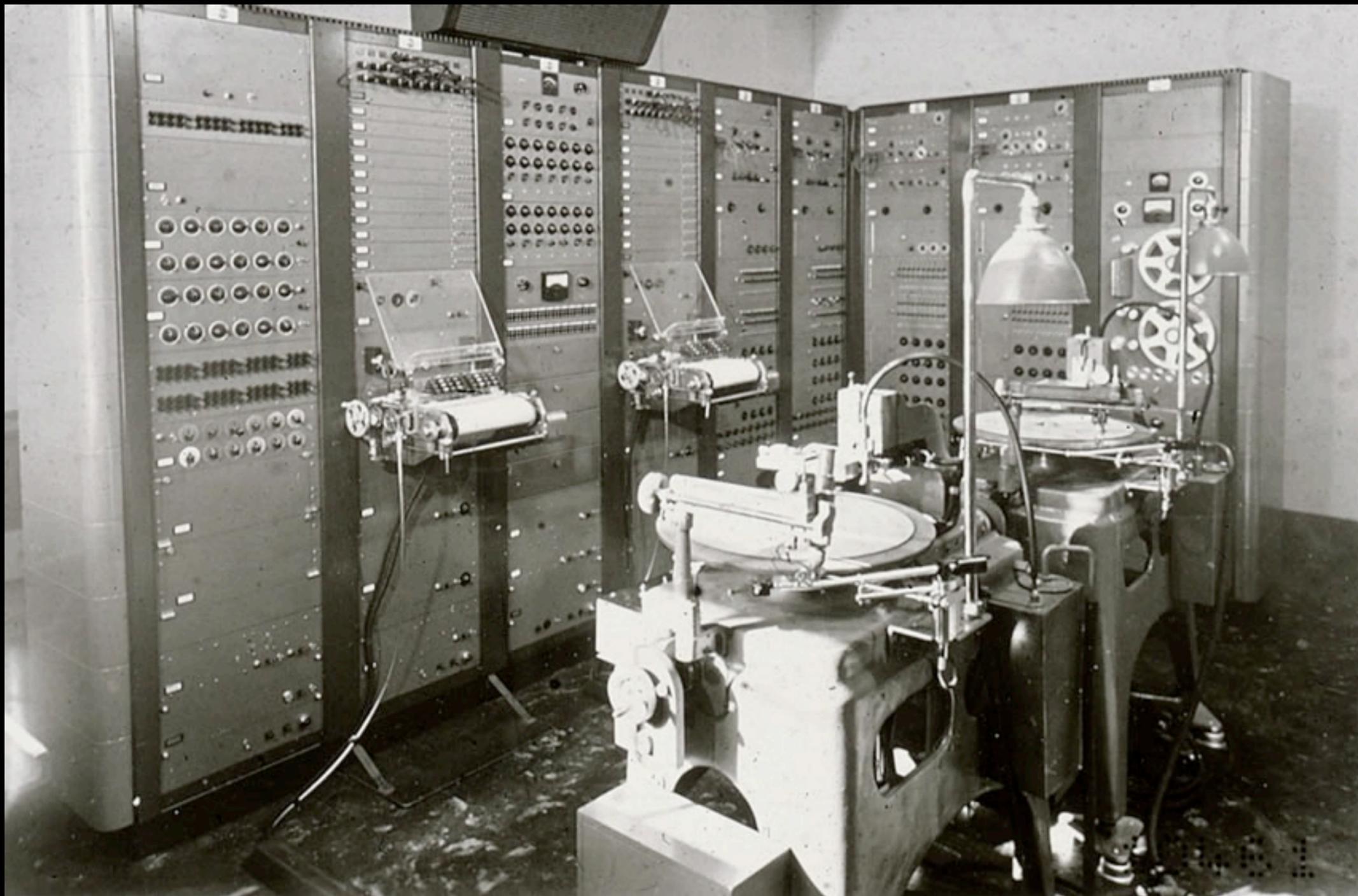
At home he pursued a life-long interest in electronic music and sound generation. In 1937, Le Caine designed an electronic free reed organ, and in the mid 1940s, he built the Electronic Sackbut, now recognised to be one of the first synthesizers. After the success of public demonstrations of his instruments, he was permitted to move his musical activities to the NRC and to work on them full time in 1954. Over the next twenty years, he built over twenty-two different new instruments.



LeCaine's Polyphonic synthesizer



Milton Byron Babbitt (May 10, 1916 – January 29, 2011) was an American composer, music theorist, and teacher. He is particularly noted for his serial and electronic music.



Babbitt later became interested in electronic music. He was hired by RCA as consultant composer to work with their RCA Mark II Synthesizer at the Columbia-Princeton Electronic Music Center (known since 1996 as the Columbia University Computer Music Center), and in 1961 produced his Composition for Synthesizer. Babbitt was less interested in producing new timbres than in the rhythmic precision he could achieve using the Mark II synthesizer, a degree of precision previously unobtainable in live performances (Barkin & Brody 2001).



Robert Moog

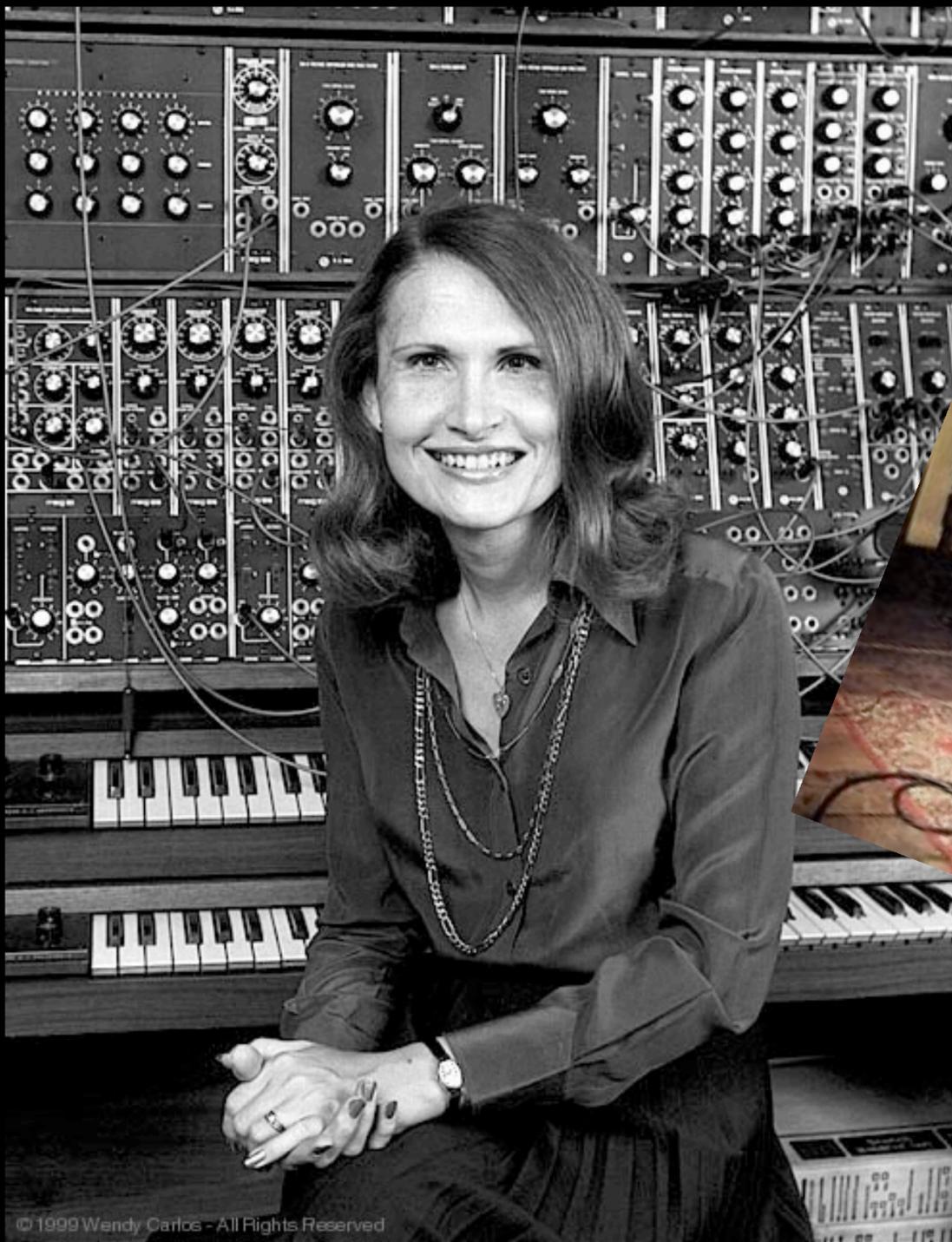
Robert Arthur Moog (pronounced /ˈmoʊg/ mohg), commonly called Bob Moog (May 23, 1934 – August 21, 2005) was an American pioneer of electronic music, best known as the inventor of the Moog synthesizer.



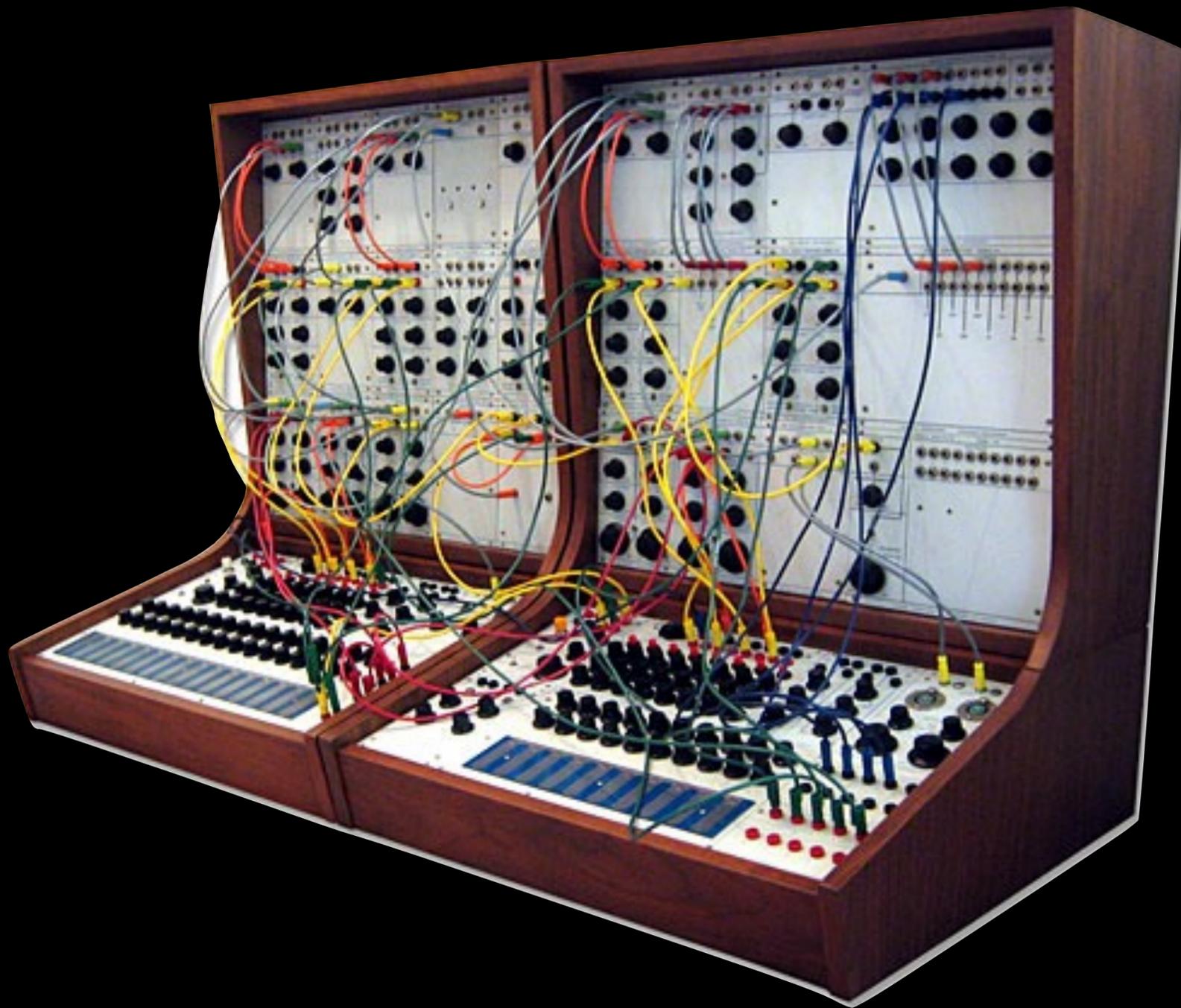
The Moog synthesizer was one of the first widely used electronic musical instruments. Early developmental work on the components of the synthesizer occurred at the Columbia-Princeton Electronic Music Center, now the Computer Music Center. While there, Moog developed the voltage controlled oscillators, ADSR envelope generators, and other synthesizer modules with composer Herbert Deutsch.

Moog created the first voltage-controlled subtractive synthesizer to utilize a keyboard as a controller and demonstrated it at the AES convention in 1964. In 1966, Moog filed a patent application for his unique low-pass filter U.S. Patent 3,475,623, which issued in October 1969. He held several dozen patents.^[1]

Moog employed his theremin company (R. A. Moog Co., which would later become Moog Music) to manufacture and market his synthesizers. Unlike the few other 1960s synthesizer manufacturers, Moog shipped a piano-style keyboard as the standard user interface to his synthesizers. Moog also established standards for analog synthesizer control interfacing, with a logarithmic one volt-per-octave pitch control and a separate pulse triggering signal.



Wendy Carlos (born Walter Carlos on November 14, 1939) is an American composer and electronic musician. Carlos first came to notice in the late 1960s (as Walter Carlos) with recordings made on the Moog synthesizer, then a relatively new and unknown instrument; most notable were LPs of synthesized Bach and the soundtrack for Stanley Kubrick's film A Clockwork Orange. Several years prior, two Carlos compositions using classical (pre-Moog) electronic techniques had been issued on LP (Variations for Flute and Tape and Dialogues for Piano and Two Loudspeakers). Although the first Carlos Moog albums were interpretations of the works of classical composers, she later resumed releasing original compositions.



Don Buchla (April 18, 1937—) is a pioneer in the field of sound synthesizers, releasing his first units months after Robert Moog's first synthesizer. However, his instrument was arguably designed before Moog's. Notable users include Morton Subotnick –Morton Subotnick (born April 14, 1933, in Los Angeles, California) is an American composer of electronic music, best known for his *Silver Apples of the Moon*, the first electronic work commissioned by a record company, Nonesuch. He was one of the founding members of California Institute of the Arts where he taught for many years. Subotnick has worked extensively with interactive electronics and multi-media, co-founding the San Francisco Tape Music Center with Ramon Sender, and often collaborating with his wife Joan La Barbara. Morton Subotnick is one of the pioneers in the development of electronic music and multi-media performance and an innovator in works involving instruments and other media, including interactive computer music systems. Most of his music calls for a computer part, or live electronic processing; his oeuvre utilizes many of the important technological breakthroughs in the history of the genre.



Aries synthesizer, Peter Zinovief's "Putney" VCS3 analogue synth with pin patch (Dark Side of the Moon, etc.)



Electrocomp 101 & Minimoog – transition to removal of patch cords and end of modularity.



Joel Chadabe is a, "composer, author and internationally recognized pioneer in the development of interactive music systems." He earned a BA from the University of North Carolina at Chapel Hill, then earned his MM at Yale while studying under Elliott Carter. His students include Liz Phillips, Richard Lainhart, and David A. Jaffe. He designed the CEMS (Coordinated Electronic Music Studio), built by Robert Moog, in 1967. He was the president of Intelligent Music, "one of the several companies that distribute software and hardware for interactive composing,"[8]from 1983 to 1994. The Electronic Music Foundation was founded in 1994 by Chadabe. Chadabe was given the SEAMUS Lifetime Achievement Award in 2007.



Alvin Lucier (born May 14, 1931) is an American composer of experimental music and sound installations that explore acoustic phenomena and auditory perception. A long-time music professor at Wesleyan University, Lucier was a member of the influential Sonic Arts Union, which included Robert Ashley, David Behrman, and Gordon Mumma. Much of his work is influenced by science and explores the physical properties of sound itself: resonance of spaces, phase interference between closely tuned pitches, and the transmission of sound through physical media.



Richard Teitelbaum (born May 19, 1939) is an American composer, keyboardist, and improvisor. Born in New York, he is a former student of Allen Forte, Mel Powell, and Luigi Nono. He is best known for his live electronic music and synthesizer performance. For example, he brought the first moog synthesizer to Europe (AMG). He is also involved with world music and uses Japanese, Indian, and western classical instruments and notation. He studied in Italy with Luigi Nono and Goffredo Petrassi. While in Italy, he became a founding member of Musica Elettronica Viva with Alvin Curran and Frederic Rzewski. He has also collaborated with Anthony Braxton, Nam June Paik, Joan Jonas, Andrew Cyrille, and Leroy Jenkins, among others.

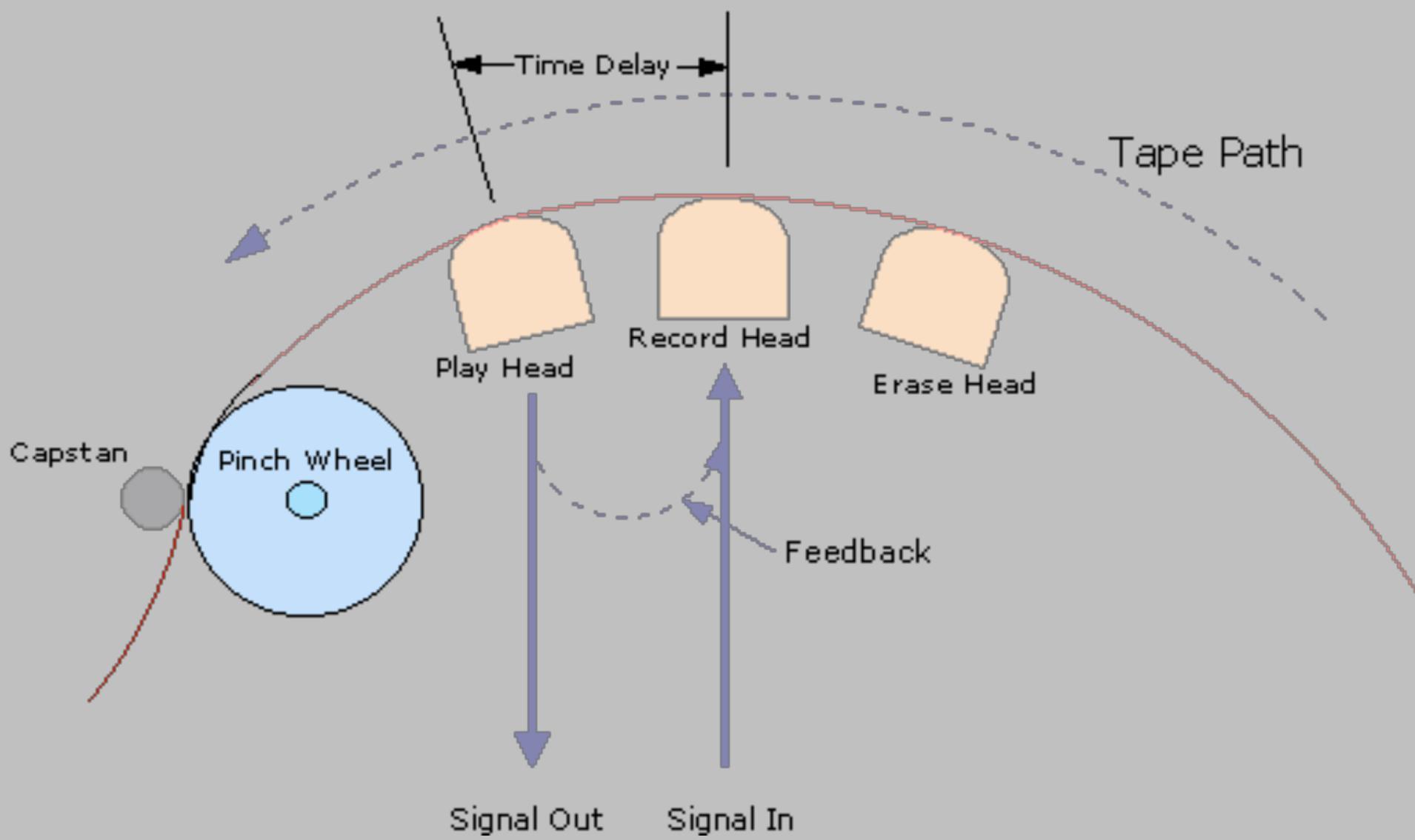


Composer Alvin Curran (born December 13, 1938), is the co-founder, with Frederic Rzewski and Richard Teitelbaum, of Musica Elettronica Viva, and a former student of Elliott Carter. Curran's music often makes use of electronics and environmental found sounds.



Barry Truax, professor acoustic communication, electroacoustic and computer music SFU (1/2 retired from Contemporary Arts in 2010)

time
based
processing

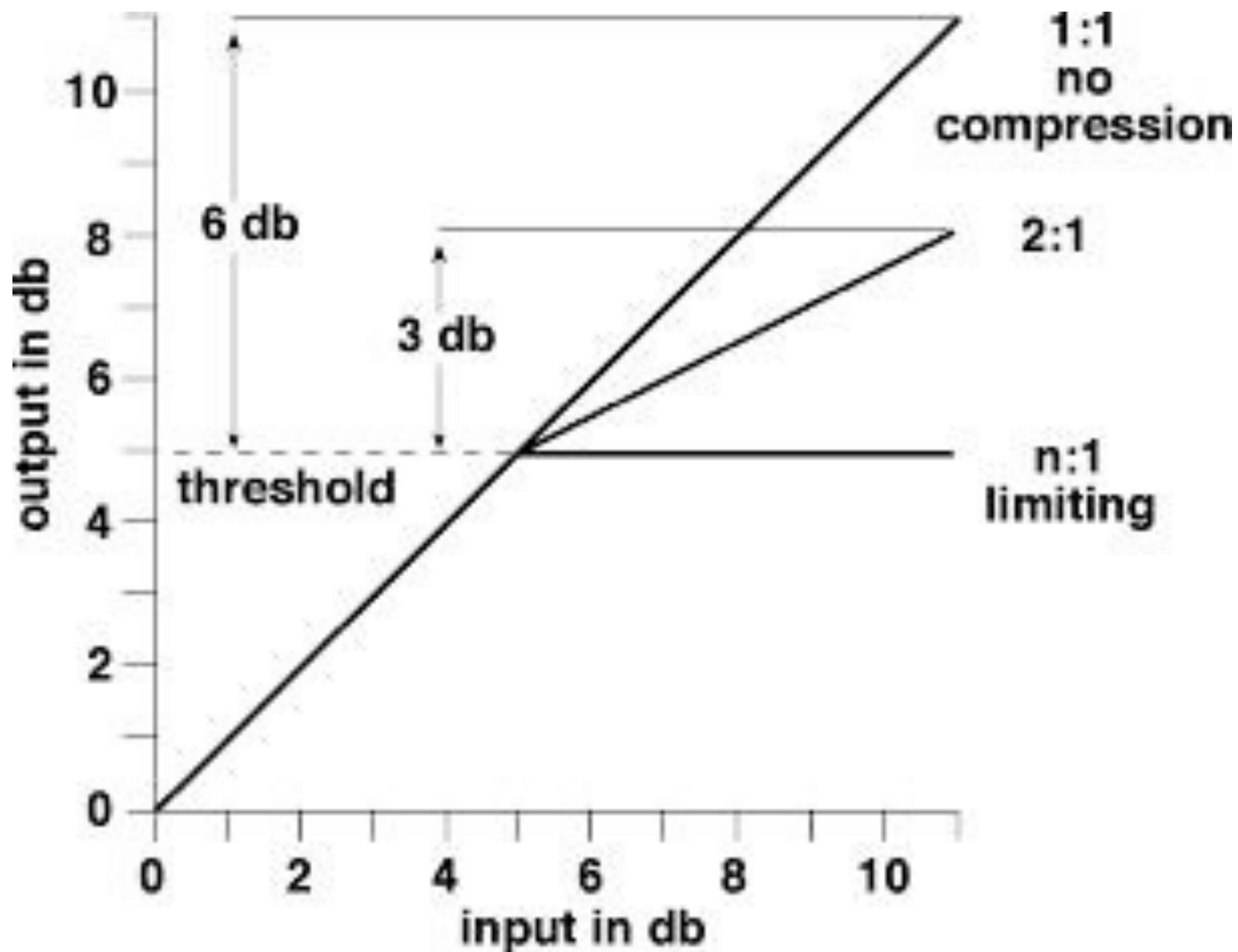


tape recorder model of time delay

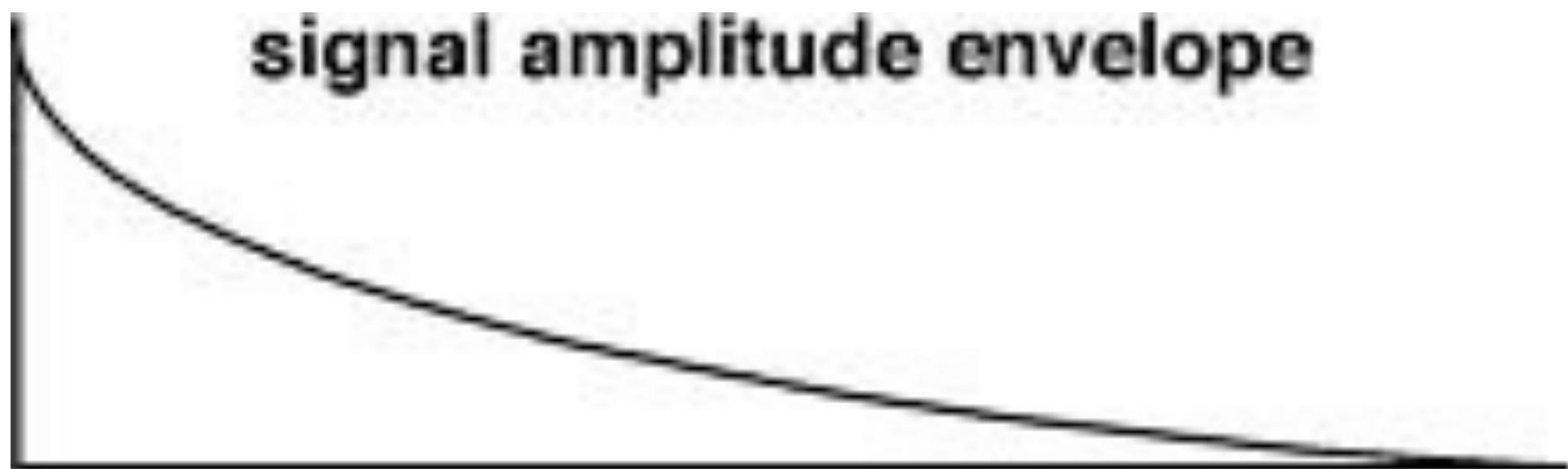
<i>Process</i>	<i>Time</i>
flanging	0.1 - 20 ms
chorus	15 - 35 ms
"echo" or reverb	50 - 100 ms
discrete delays	100 +

dynamic
processing

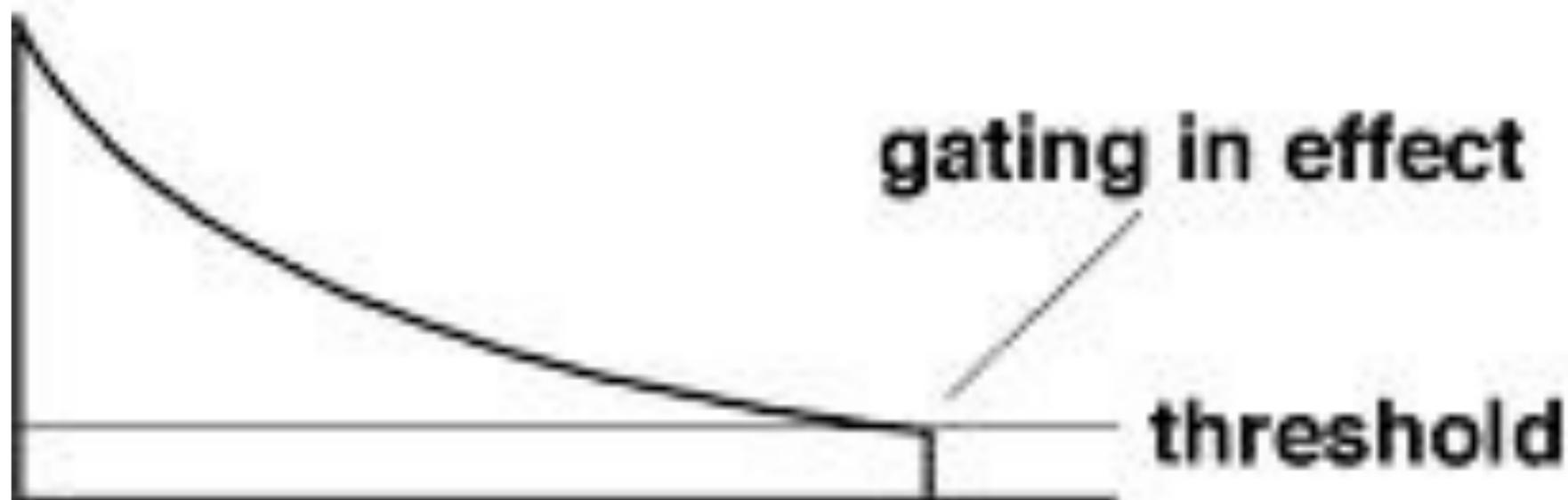
compression	ratio
expansion	attack time
limiting	release time
	threshold
gating	threshold



signal amplitude envelope



gating in effect



end

end