Historia de la Música Electroacústica

V
Computer Music - los comienzos
de fines de la década de 1950 hasta ca. 1970

Max V. Mathews (1926 – 2011)

IBM 704 (1954)

Max Mathews, Bell Laboratories

- MUSIC (MUSIC I) – 1957

  IBM 704, assembler
  monofónico, una sola forma de onda (triangular), sin envolventes, sólo se podía controlar tiempo de inicio y final de cada nota, su amplitud y frecuencia

- MUSIC II – 1958

  IBM 704, assembler
  polifónico (cuatro voces), 16 formas de onda diferentes, osciladores por lectura de tabla

Newman Guttmann

In the Silver Scale [1957]

Max Mathews, Bell Laboratories

- MUSIC III – 1960
  IBM 7090, macro assembler
  introduce las unidades generadoras

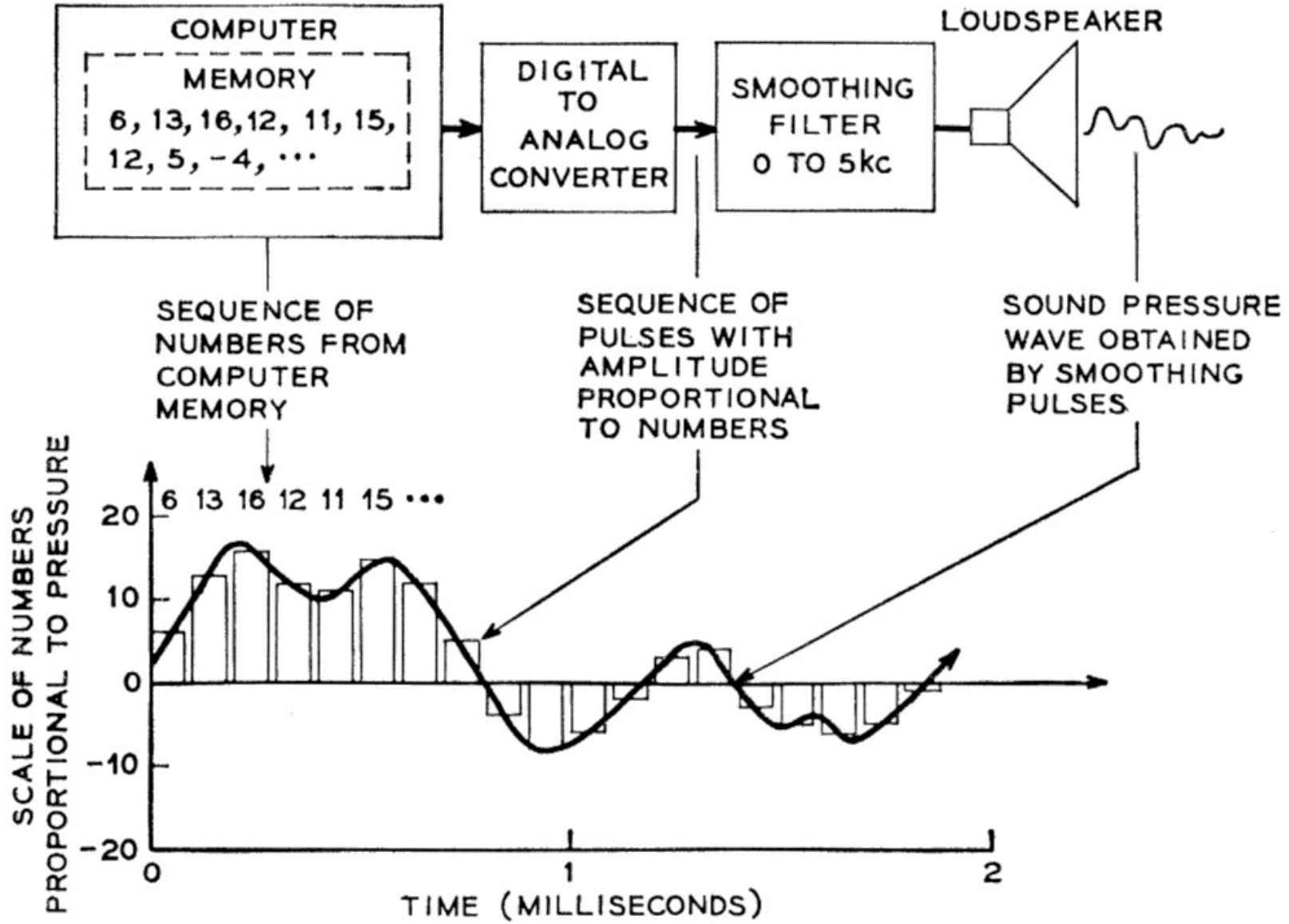
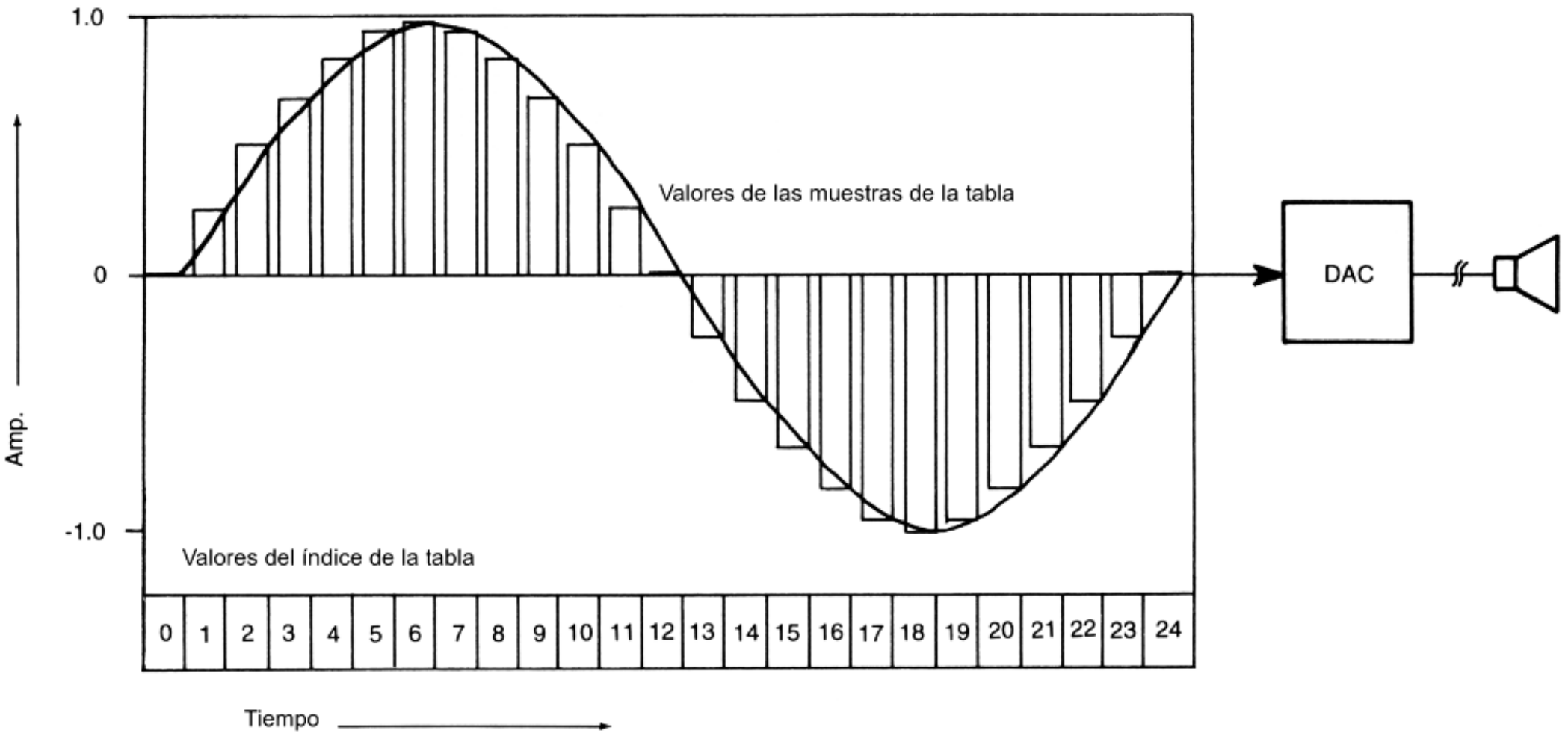
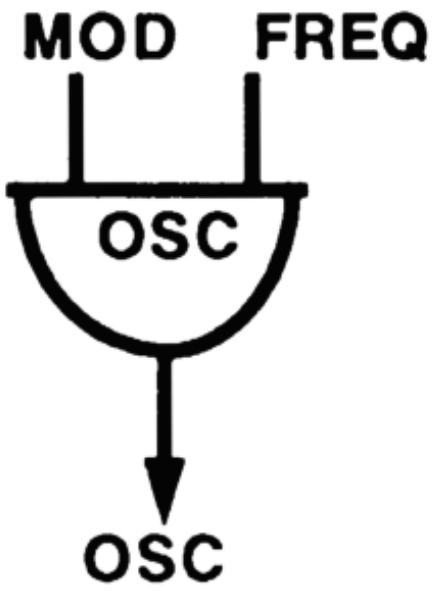
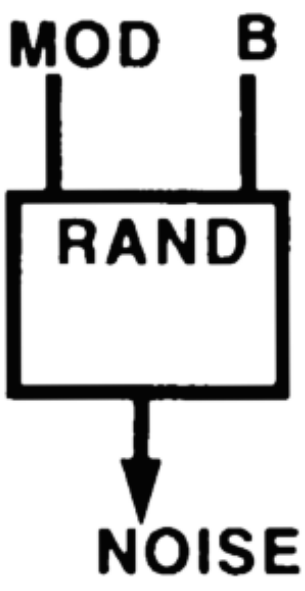


Fig. 1. Schematic diagram depicting the conversion of a sequence of numbers stored in a computer memory to a sound pressure wave form. The sampling rate is 10,000 numbers per second to yield a bandwidth of 5000 cycles per second for the sound wave.


1.0
0
-1.0
Amp.
Valores de las muestras de la tabla
DAC
Valores del índice de la tabla
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Tiempo





OSC=MOD*G(FREQ)

NOISE=MOD*RAND(B)

SUM = IN1+IN2

Fig. 2 Instrument Parts

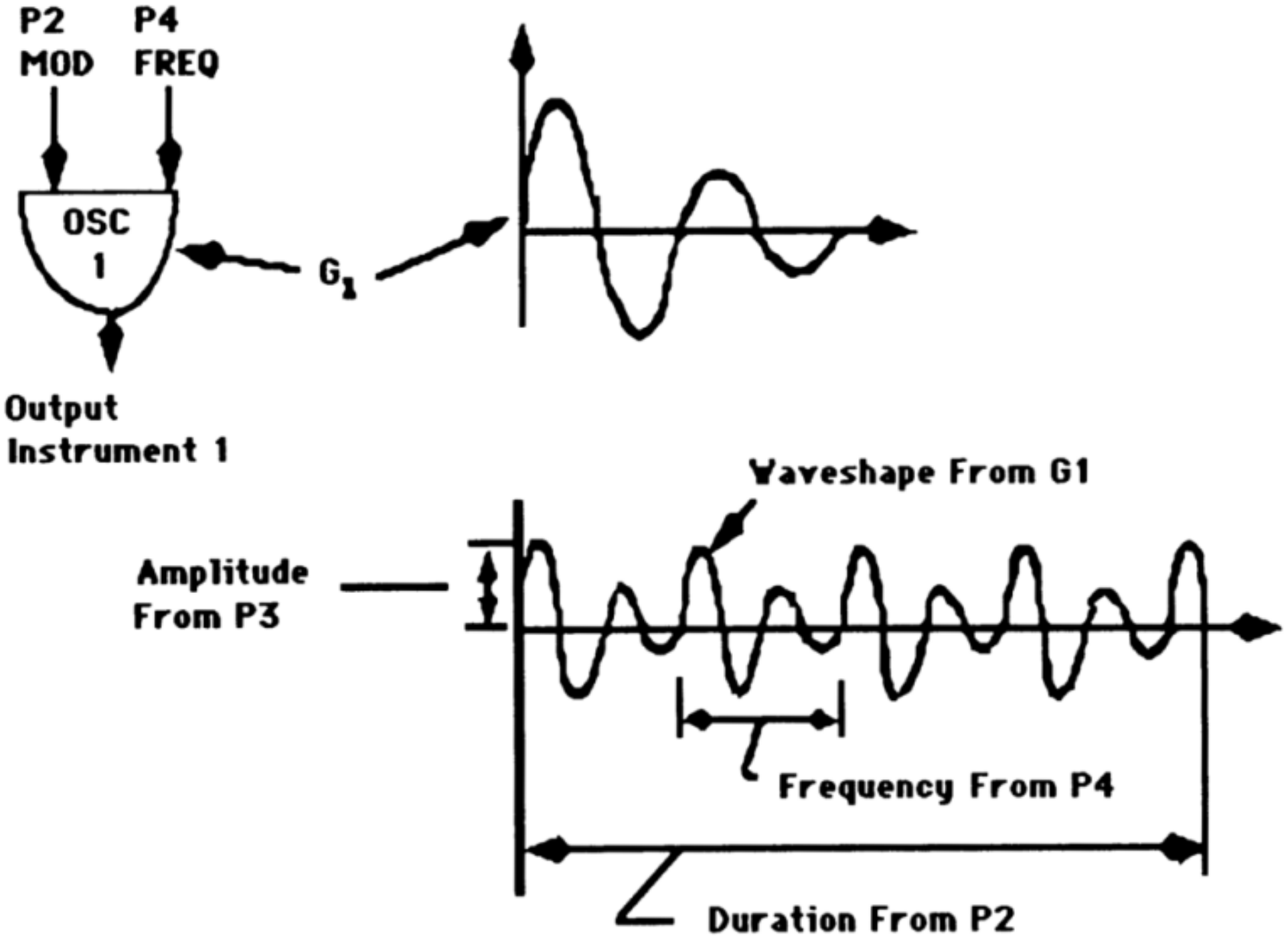


Fig. 3 A Simple Instrument

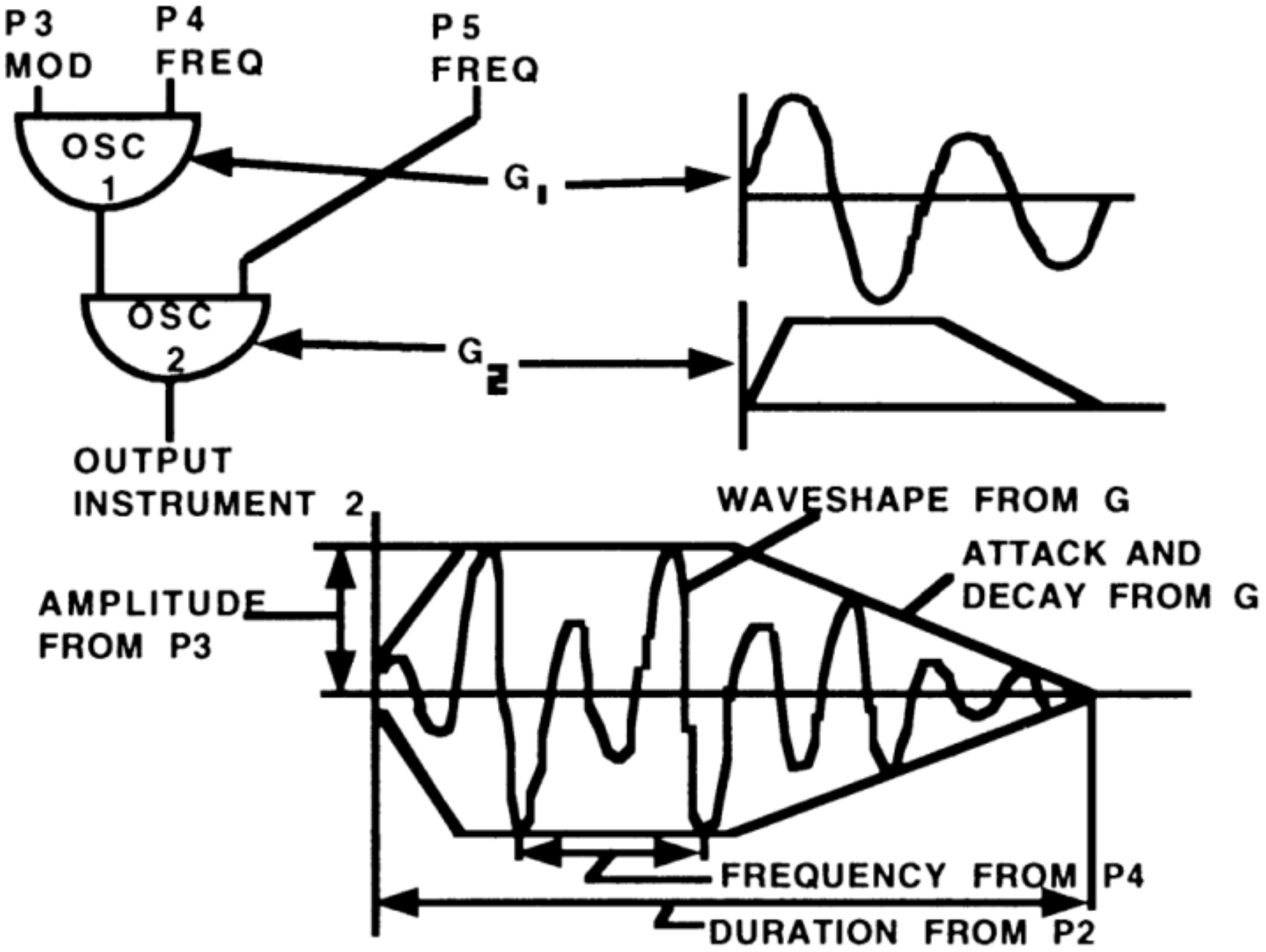


Fig. 4 Instrument with Attack

Max Mathews

Numerology [1960]

Max Mathews, arr.

Bicycle built for two [1961]

James Tenney

Noise Study [1961]

Max Mathews, Bell Laboratories

- MUSIC IV – 1963

  IBM 7094, macro assembler
  amplía la cantidad de operadores, capacidad estereofónica,
  comienza su difusión, da origen a la familia Music-N

- MUSIC V – 1966

  GE 645, Fortran IV
  portado a múltiples plataformas

IBM 7094 (1962)

- 1963: “The Digital Computer as a Musical Instrument.” In *Science* 01 Nov 1963: Vol. 142, Issue 3592, pp. 553-557

“With the aid of suitable output equipment, the numbers which a modern digital computer generates can be directly converted to sound waves. The process is completely general, and any perceivable sound can be so produced.”

“There are no theoretical limitations to the performance of the computer as a source of musical sounds, in contrast to the performance of ordinary instruments.”

“...the range of computer music is limited principally by cost and by our knowledge of psychoacoustics. These limits are rapidly receding.”

Max Mathews: “The Digital Computer as a Musical Instrument.” 1963.

- Jean-Claude Risset (1938 –)
  1964–65, 1967–69: investigación sobre timbre y técnicas de síntesis en los Bell Laboratories

Jean-Claude Risset

Mutations [1969]

Ercolino Ferretti

Trio [1965]

James Randall

Mudget, Monologues for a Mass Murderer [1965]

- 1969: *The Technology of Computer Music*. MIT Press.

Familia Music-N

- MUSIC IVB - 1965

  Winham & Howe, Princeton University
  IBM 7094, macro assembler

- MUS10 - 1966

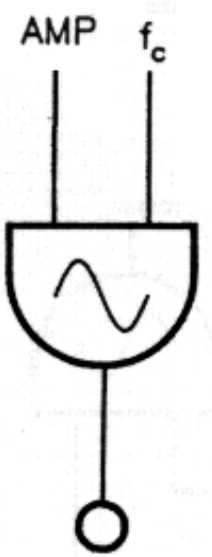
  Chowning, Poole & Smith, Stanford University
  DEC PDP-10, PDP-10 assembler

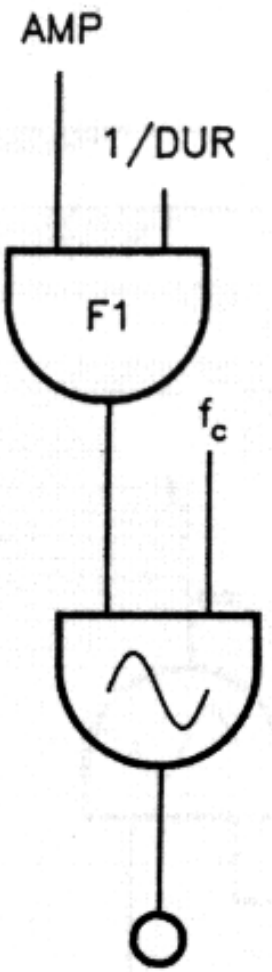
- MUSIC 4BF - 1967

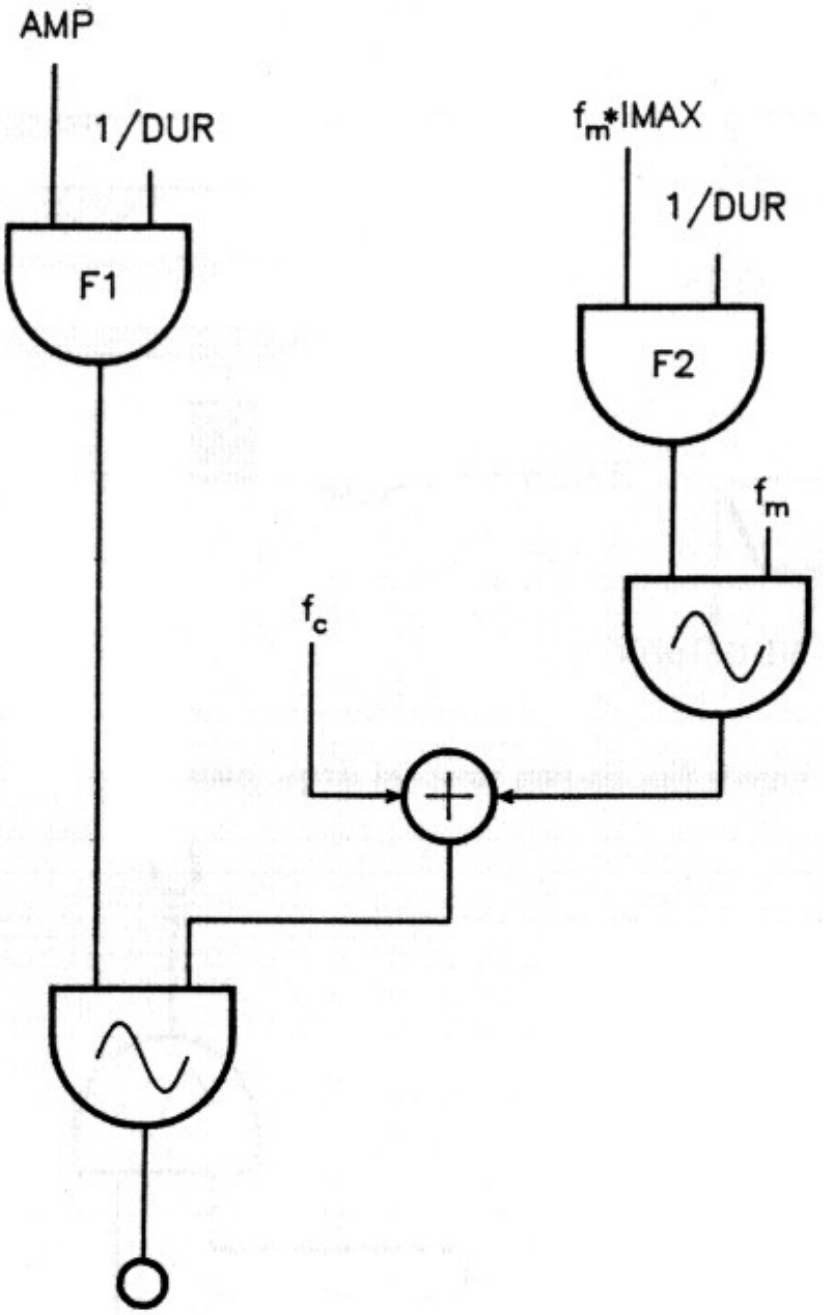
  Winham & Howe, Princeton University
  IBM 360, Fortran II & BAL assembler

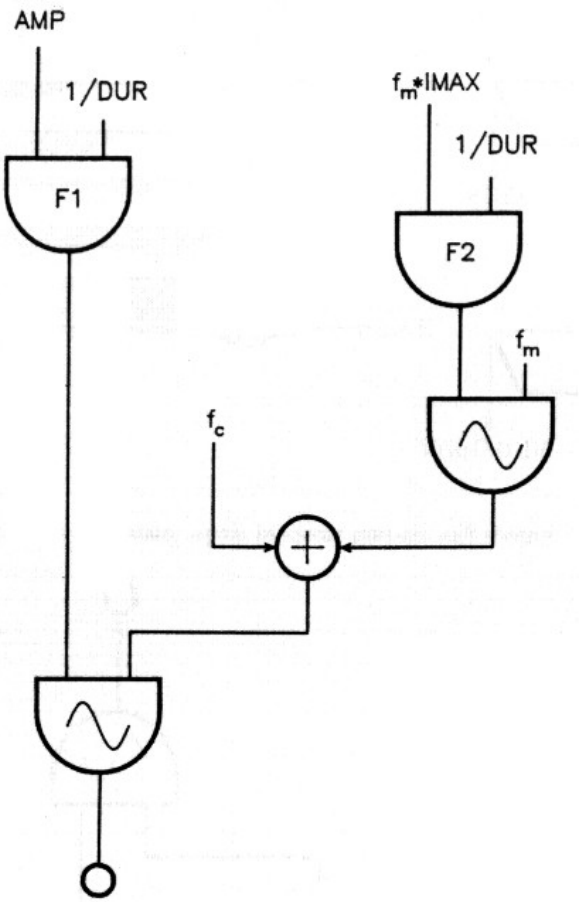
síntesis FM

- John Chowning (1934 –)
  1968: investigación sobre síntesis de audio por modulación de frecuencia en la Stanford University


AMP
f_c


AMP
1/DUR
F1
f_c


AMP
1/DUR
F1
f_m*IMAX
1/DUR
F2
f_m
f_c



$$x(t) = \text{sen}(\alpha t + I\ \text{sen}\beta t)$$

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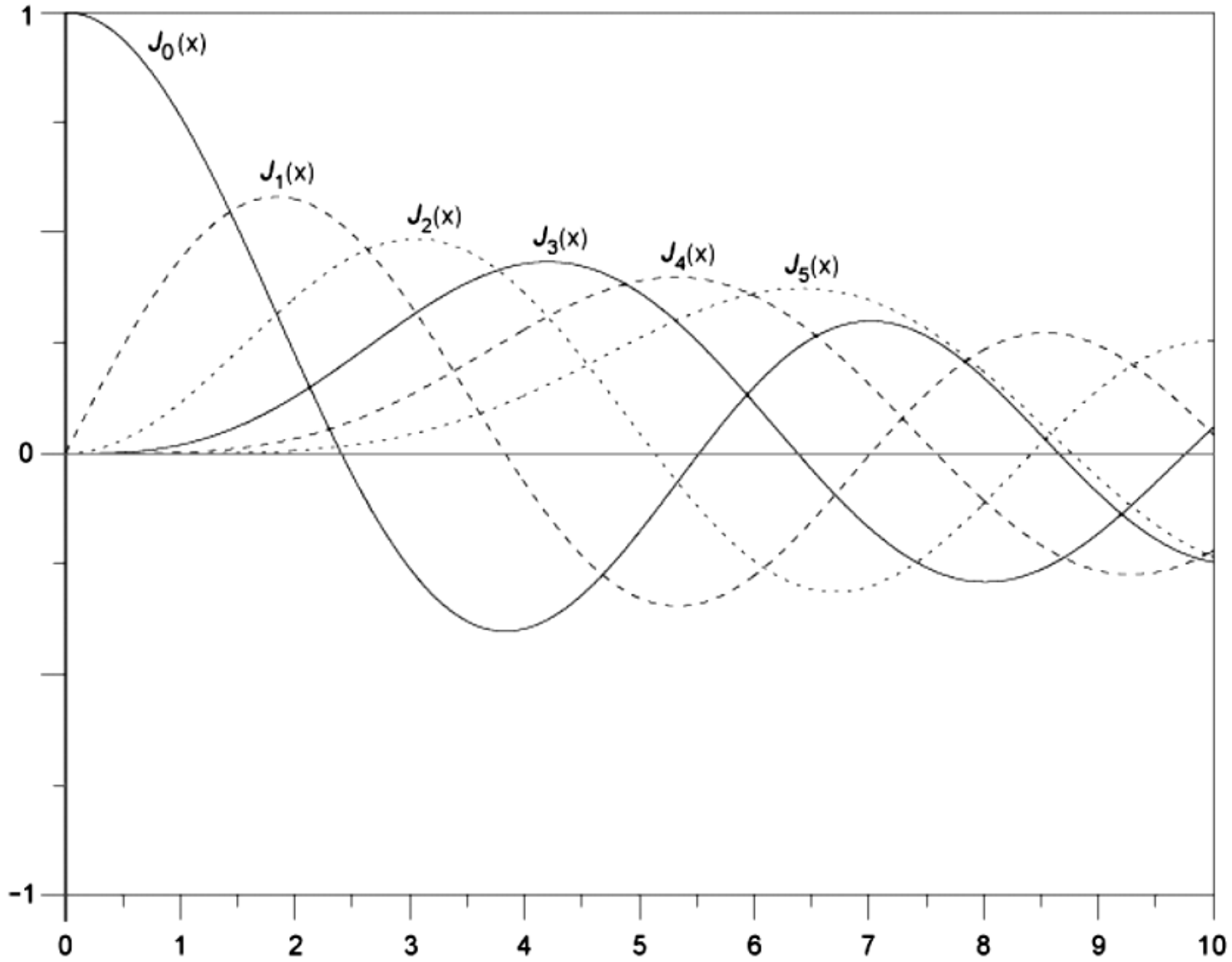
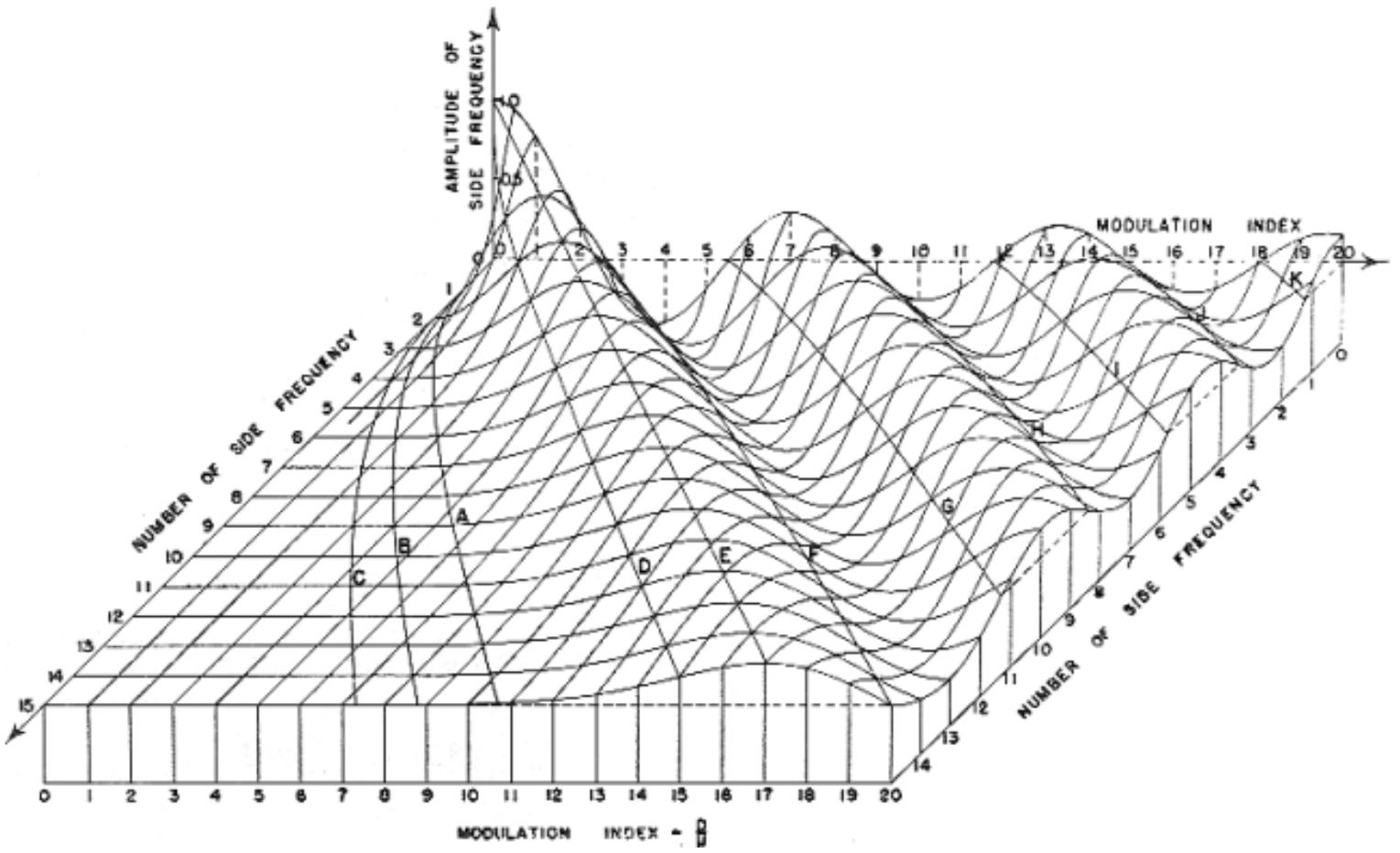
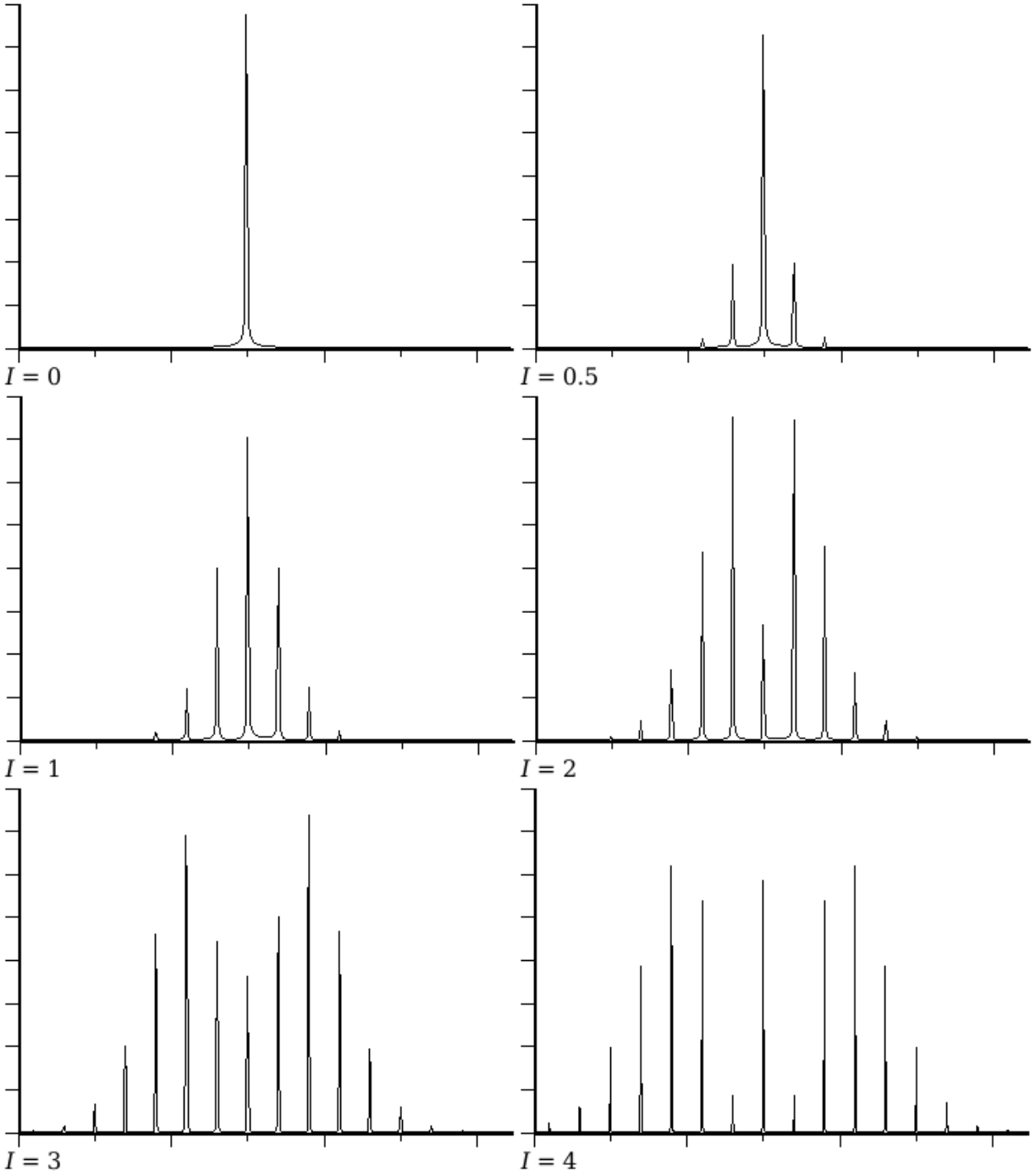
$$\begin{aligned} x(t) \;=\; & J_0(I)\text{sen}\alpha t \\ & + J_1(I)[\text{sen}(\alpha + \beta)t - \text{sen}(\alpha - \beta)t] \\ & + J_2(I)[\text{sen}(\alpha + 2\beta)t + \text{sen}(\alpha - 2\beta)t] \\ & + J_3(I)[\text{sen}(\alpha + 3\beta)t - \text{sen}(\alpha - 3\beta)t] \\ & + \ldots \end{aligned}$$


1
0
−1
0
1
2
3
4
5
6
7
8
9
10
$J_0(x)$
$J_1(x)$
$J_2(x)$
$J_3(x)$
$J_4(x)$
$J_5(x)$


AMPLITUDE OF SIDE FREQUENCY
1.0
0.5
0
MODULATION INDEX
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
NUMBER OF SIDE FREQUENCY
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
A
B
C
D
E
F
G
H
K
MODULATION INDEX = β


$I = 0$
$I = 0.5$
$I = 1$
$I = 2$
$I = 3$
$I = 4$

John Chowning

Turenas [1972]