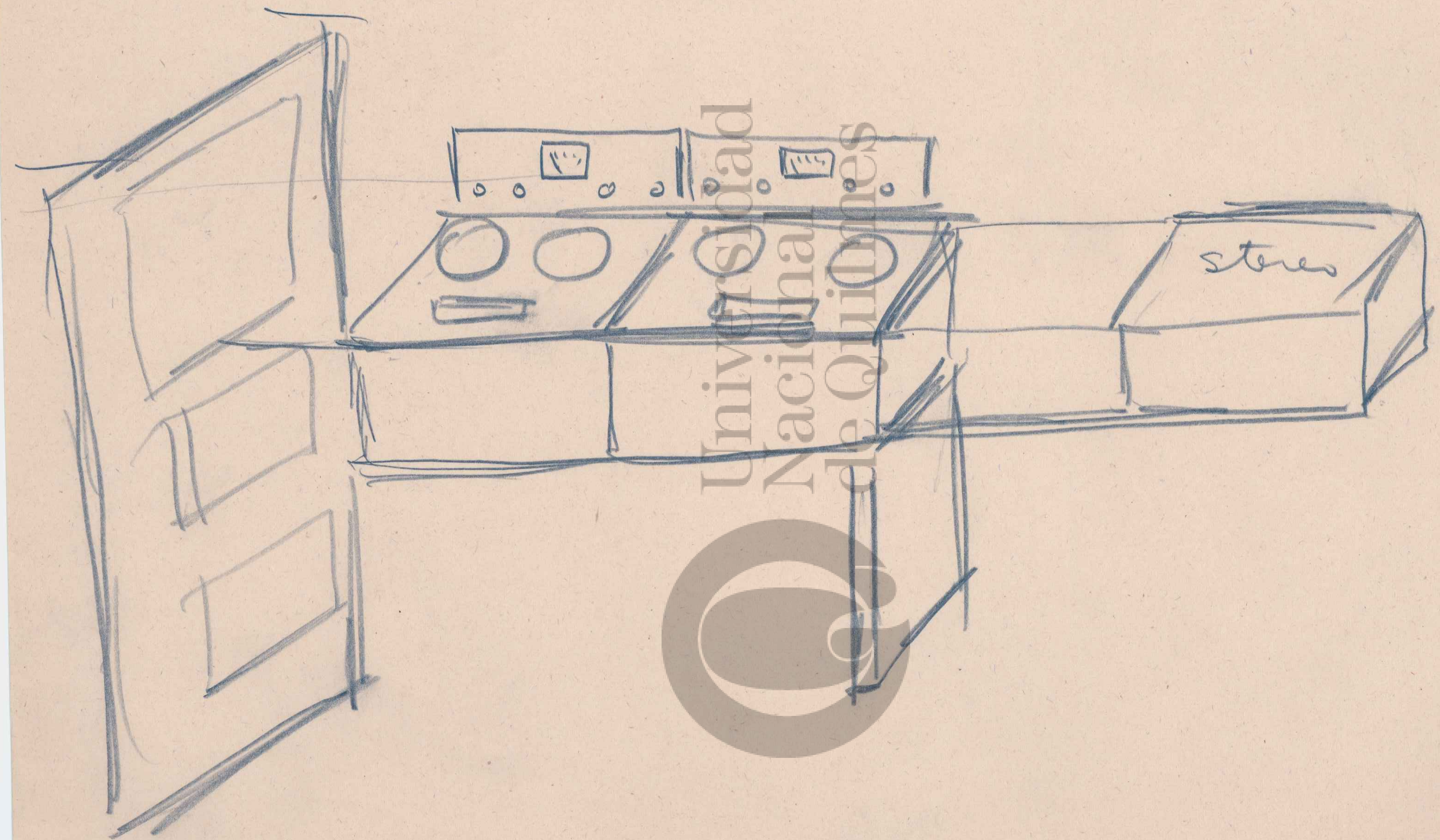

stereo

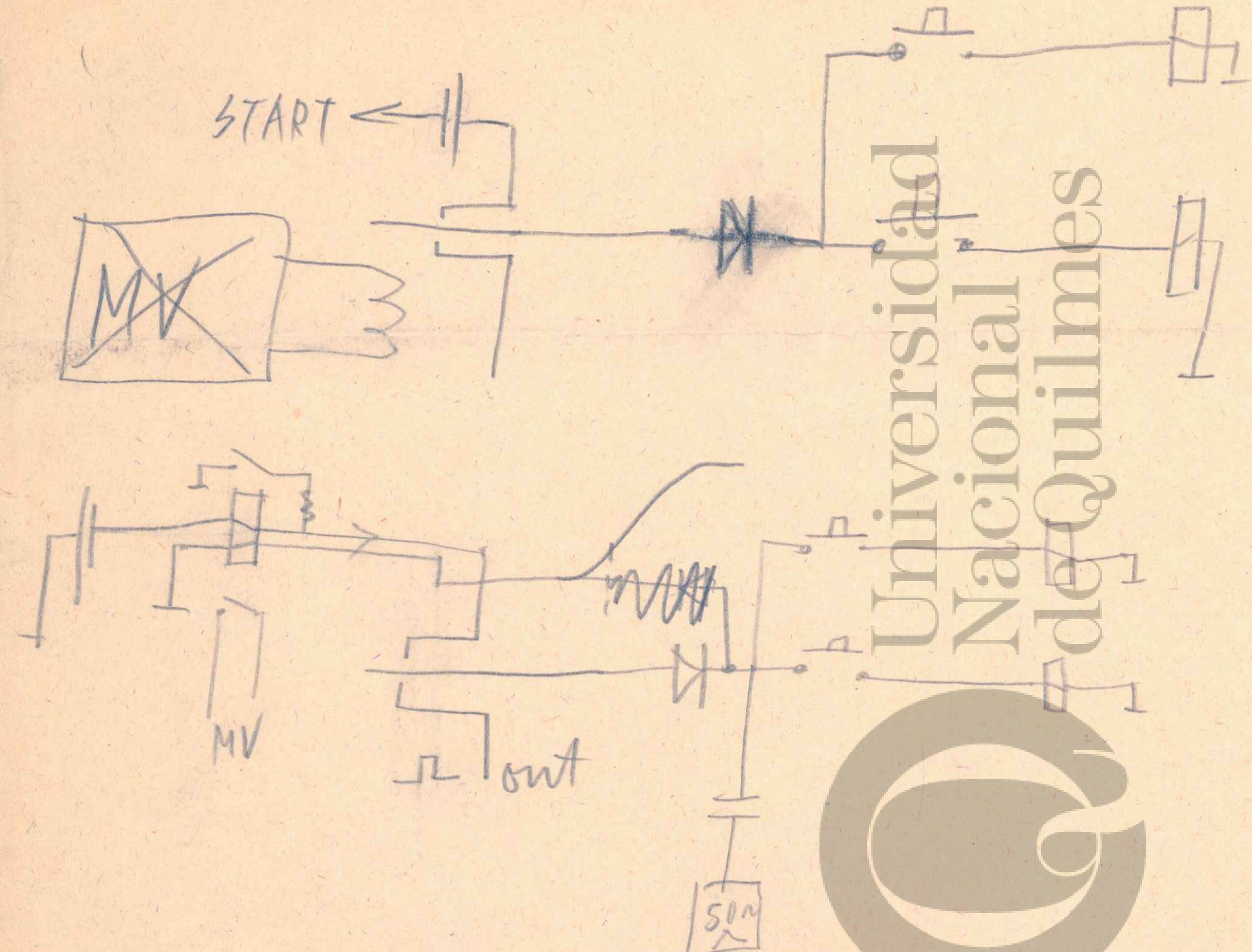
Joel Spiegelman (ARP)
SARAH LAWRENCE COLLEGE

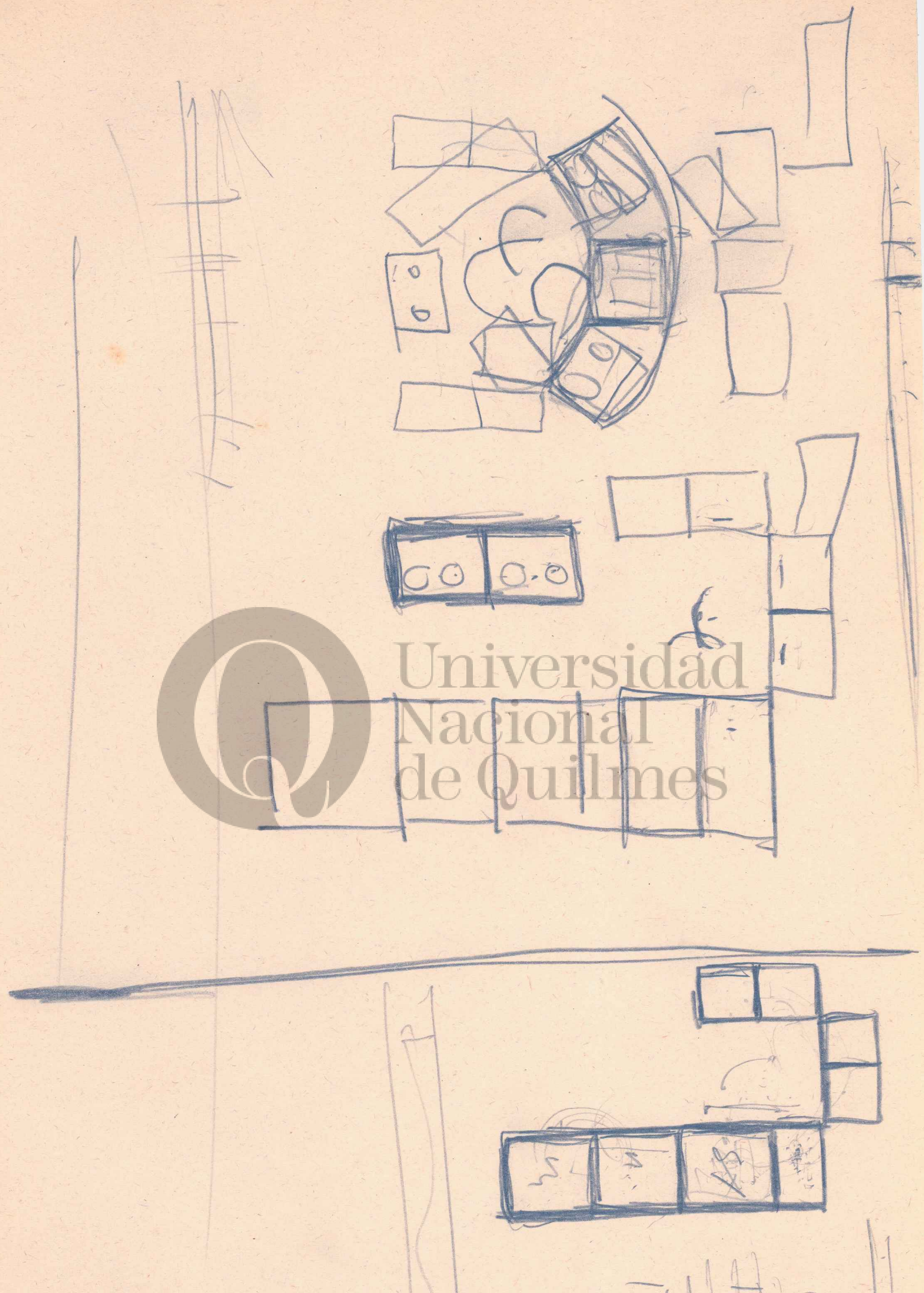
Henry Hudson Hotel 57 y 8ª Av

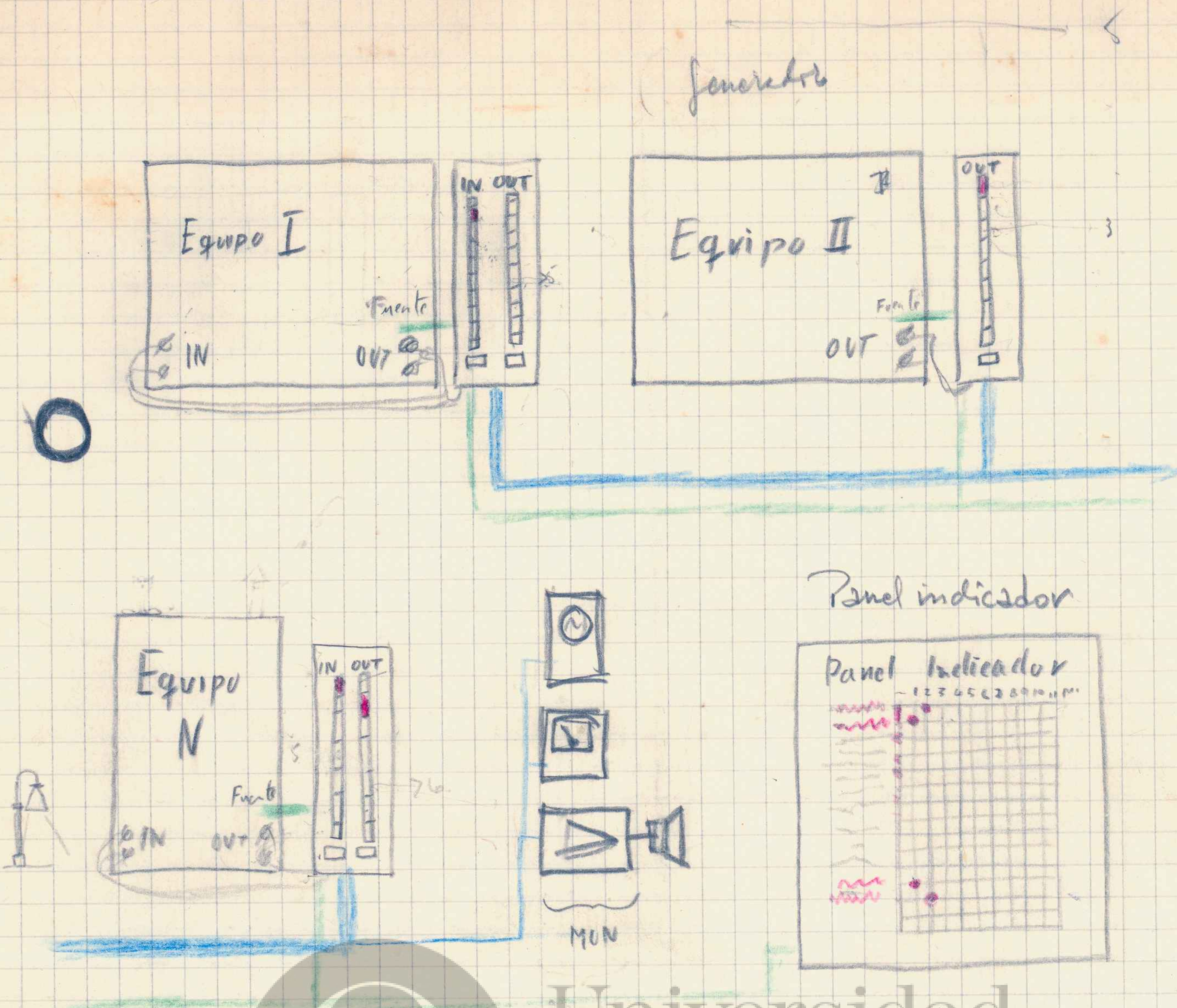
10 dic
N. Y. [illegible]

Aleiler

McGILL University
Faculty of Music
3605 MOUNTAIN ST.
MONTREAL, Canada (109)


START
MV
MV
out
50Ω





Equipos

			TECLAS
	I	oscilador 1 sinusoidal	1 2 3 4 5 6 7 8 9 10
		oscilador 1 cuadrada	1 2 3 4 5 6 7 8 9 10
	II	oscilador 2 sinusoidal	1 2 3 4 5 6 7 8 9 10
		oscilador 2 cuadrada	1 2 3 4 5 6 7 8 9 10
	III	oscilador 3 sinusoidal	1 2 3 4 5 6 7 8 9 10
		oscilador 3 cuadrada	1 2 3 4 5 6 7 8 9 10
X	IV	modulador en anillo in	1 2 3 4 5 6 7 8 9 10
		modulador en anillo in	1 2 3 4 5 6 7 8 9 10
		modulador en anillo out	1 2 3 4 5 6 7 8 9 10
M.D.	V	modulador de ~~transient~~ dinámico in	1 2 3 4 5 6 7 8 9 10
		in	1 2 3 4 5 6 7 8 9 10
		out	1 2 3 4 5 6 7 8 9 10
	VI	reverberación entrada	1 2 3 4 5 6 7 8 9 10
		salida	1 2 3 4 5 6 7 8 9 10
	VII	mezclador entrada 1	1 2 3 4 5 6 7 8 9 10
		2	1 2 3 4 5 6 7 8 9 10
		3	1 2 3 4 5 6 7 8 9 10
		4	1 2 3 4 5 6 7 8 9 10
		salida 1	4 5 6 7 8 9 10 11 12 13
		2	4 5 6 7 8 9 10 11 12 13
	VIII	grabador A in 1	4 5 6 7 8 9 10 11 12 13
		2	4 5 6 7 8 9 10 11 12 13
		out 1	6 7 8 9 10 11 12 13 14 15
		out 2	6 7 8 9 10 11 12 13 14 15
	IX	monitor 1 in	6 7 8 9 10 11 12 13 14 15
		monitor 2 in	6 7 8 9 10 11 12 13 14 15

26 tecl[illegible]

atención: Monitoreo fijo a salida de grabador (dos canales).
→ a veces es muy necesario el monitoreo separado de 4 pistas (de lectura)

ORGANIZACIÓN INTERCONEX.

(1)

OSCILADOR I1			A
OSCILADOR I2			B
OSCILADOR I3			C
OSCILADOR II1			D
OSCILADOR II2			E
OSCILADOR II3			F
OSCILADOR II4			
OSCILADOR I4			
OSCILADOR I5			
GENERADOR I6			
~~XZMEZCZRZXZAZX~~			
~~+XZMEZCZPZXZBZX~~			
~~XZMEZCXPZXZCZXZX~~			
~~XZMEZCXPZXZDZXZX~~			
G. PULS ALEAT.	II 5		
ONDAS PEREZ	II 6	o	
Ruido blanco			X
+ MEZCL PAS A	I-II	o	
+ MECL PAS B	I-II	o	
+ MEZCL P?. C	I-II	o	
+ MEZCL P. B	I-II	o	
IN A1	M	I	x
IN A2	M	I	x
IN A3	M	I	x
IN B1	M	I	x
IN B2	M	I	x
IN B3	M	I	x
OUT A	M	o	x
OUT B	14	o	x

ga 18-19

OSCILADOR

OSCILADOR

OSCILADOR

OSCILADOR

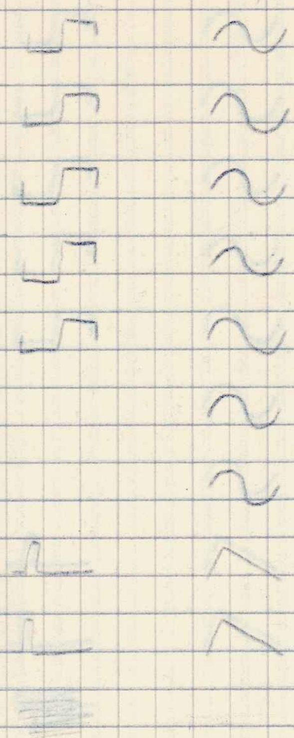
OSCILADOR

OSCILADOR

OSCILADOR

OSCILADOR

OSCILADOR



GENERADOR

~~+ MEZCL P. A~~

~~+ MEZCL P. B~~

~~+ MEZCL P. C~~

~~+ MEZCL P. D~~

G. PULS ALEAT.

ONDAS PEREZ

+ MEZCL PAS A

+ MECL PAS B

+ MEZCL P?. C

+ MEZCL P. B

IN A1

IN A2

IN A3

IN B1

IN B2

IN B3

OUT A

OUT B

SELECTOR AMPLITUD			J	0	
FILTRO KRΘHN I	IV 1		J	0	XX
FILTRO KROHN II	III 2		J	0	8M + 26
FILTRO B Y KJ			J	0	
MOD ANILLO I		J	J	0	XXX
MOD ANILLO LL		J	J	0	
LL ELECTR I		J	J	0	XXX
LL ELECTR II		J	J	•	
PARABOLA		~~J~~	J	0	
RECORTADOR		~~J~~	J	0	
COMPRESOR			J	0	
MOD TRANSIENTES I		context J	J	0	XX
MOD TRANSIENTES II		J	J	0	XX
MOD DINAMICO		J	J	0	
MODULADOR LUMINICO			J	0	
			J		
			J	0	
			J		
REVERBERACIO N I			J	0	
REVERBERACION II			J	0	

SELECTOR AMPLITUD

FILTRO KROHN I

FILTRO KROHN II

FILTRO B Y KJ

MOD ANILLO I

MOD ANILLO II

LL ELECTR I

LL ELECTR II

PARABOLA

RECORTADOR

COMPRESOR

MOD TRANSIENTES I

MOD TRANSIENTES II

MOD DINAMICO

MODULADOR LUMINICO

REVERBERACIO N I

REVERBERACION II

AMPEX MONO II		I	0	XX
AMPEX MONO I		I	0	XX
AMPEX STEREO	7	I	6	XXXX
		I	0	
GRAB EXTERNO		I	0	
" "		I	0	
MONITOR AMPEX I		I		X
MONITOR AMPEX II		I		X
CONTADOR		I		X
OSCILOSCOPIO X		I		X
Y		I		
Z		I		
VUMETRO		I		X
MEDIDOR PICO		I		

AMPEX MONO II

AMPEX MONO I

AMPEX STEREO

GRAB EXTERNO

MONITOR AMPEX I

MONITOR AMPEX II

CONTADOR

OSCILOSCOPIO X

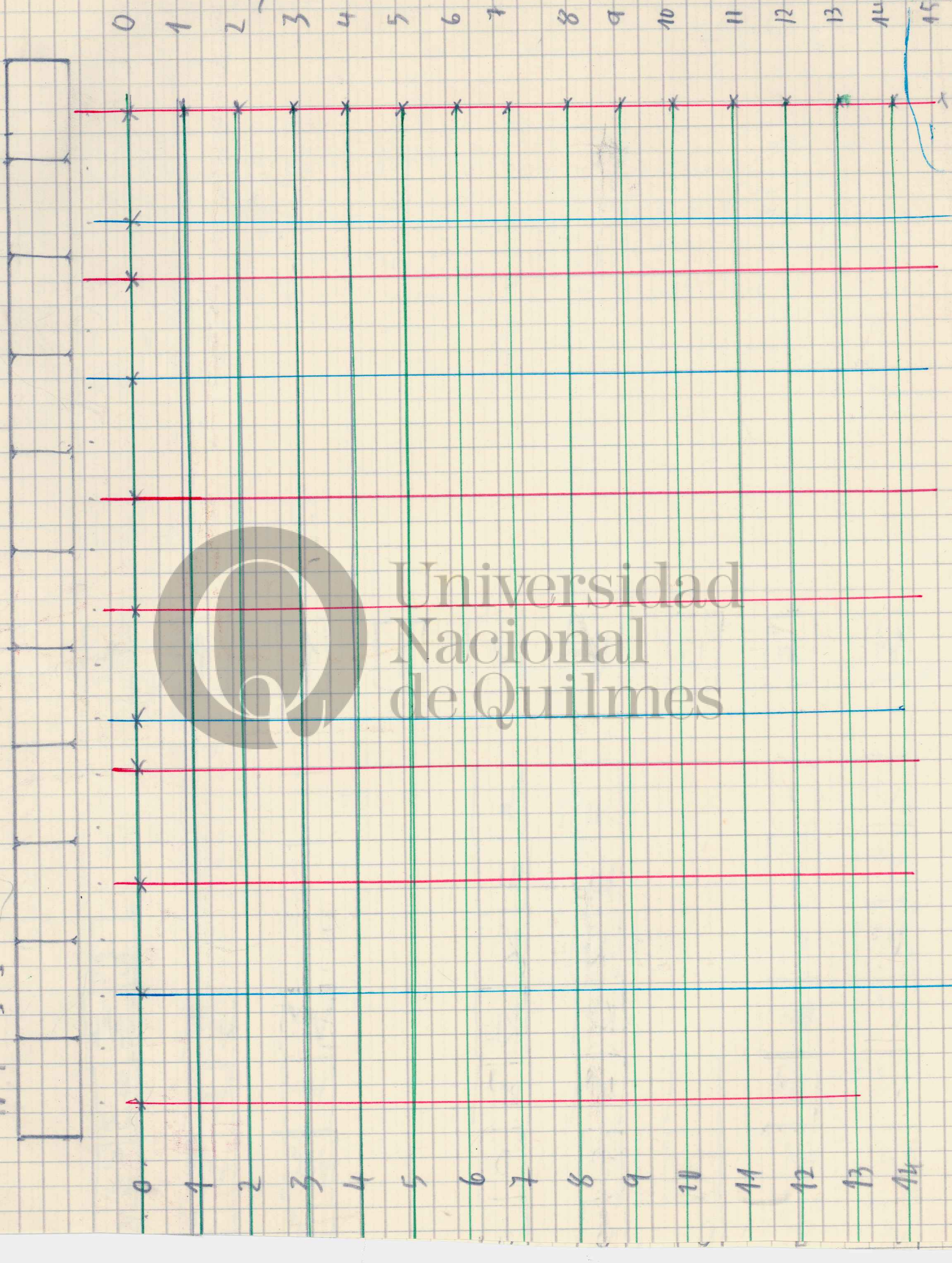
Y

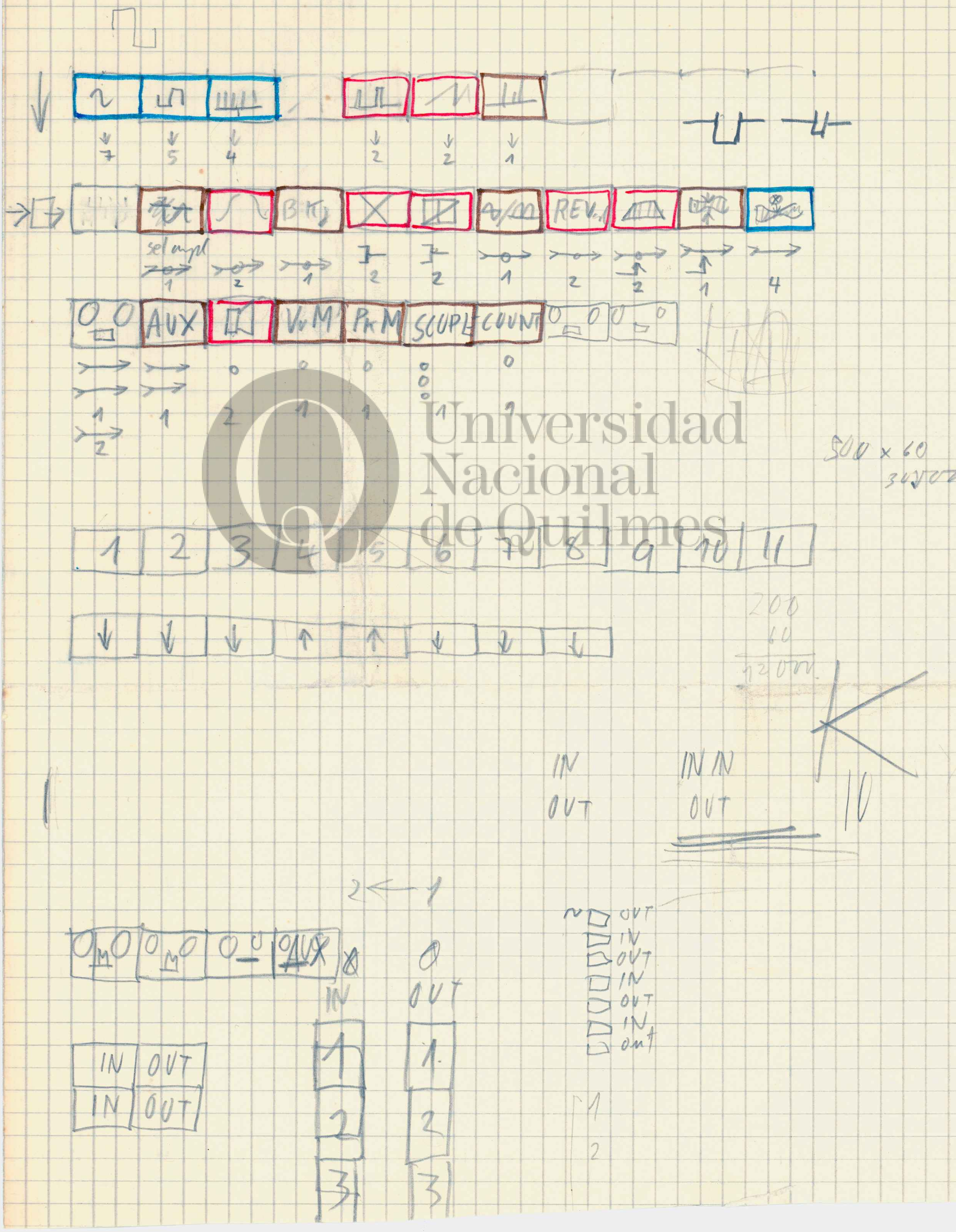
Z

VUMETRO

MEDIDOR PICO

Corresp. botonera-cuadricula




7 5 4 2 2 1
BK
REV
sel ampl
1 2 1 2 2 1 2 2 1 4
AUX
VM
PM
SCUPL
COUNT
1 1 2 1 1 1 1
2
500 x 60
1 2 3 4 5 6 7 8 9 10 11
200
60
12000
IN
OUT
IN IN
OUT
2 ← 1
OUT
IN
OUT
IN
OUT
IN
OUT
AUX
IN
OUT
IN OUT
IN OUT
1 2 3
1 2 3
1
2


Π3
Π4
Π5
Λ1
Λ2
O
Bk
KF
MT
M
AST2
Aux1
Aux2
CRT V
CRT B
VnM
Cont

1:75

Cabin

amplif 1 222

amplif 11222

~~Mixer~~ amplif 222

~~Amplif~~ ~~222~~

BAA botonera 311

133 Monitor

UPH 222

Mixer 222

Pre's 133

24V ~~2~~22

Ry 133

222

133 2 Schmitt 2 amplif 1 pulsin def

311 10 botones

133 2 med tremol

10 h 311 ~~133~~

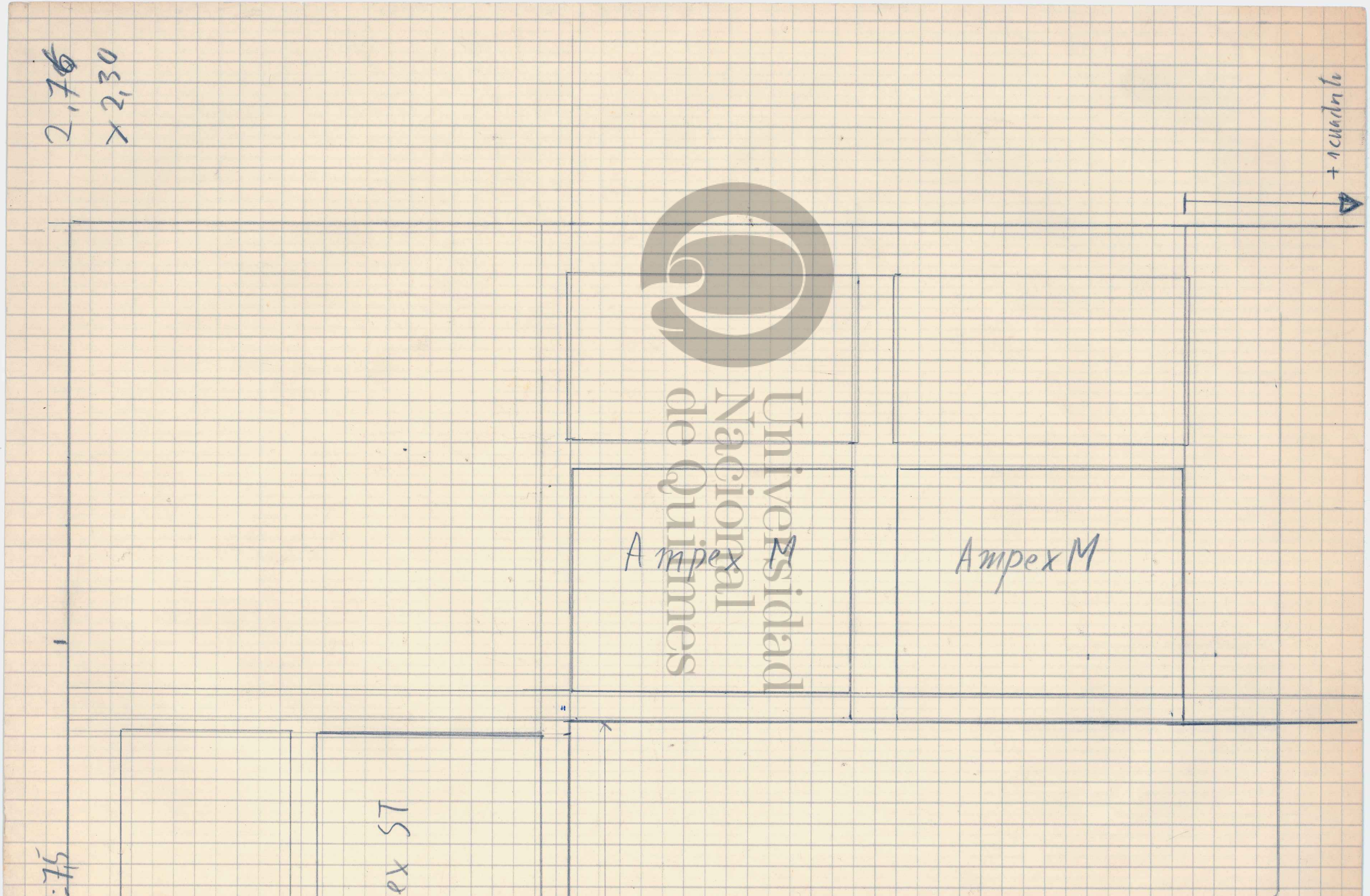
267 ~~222~~

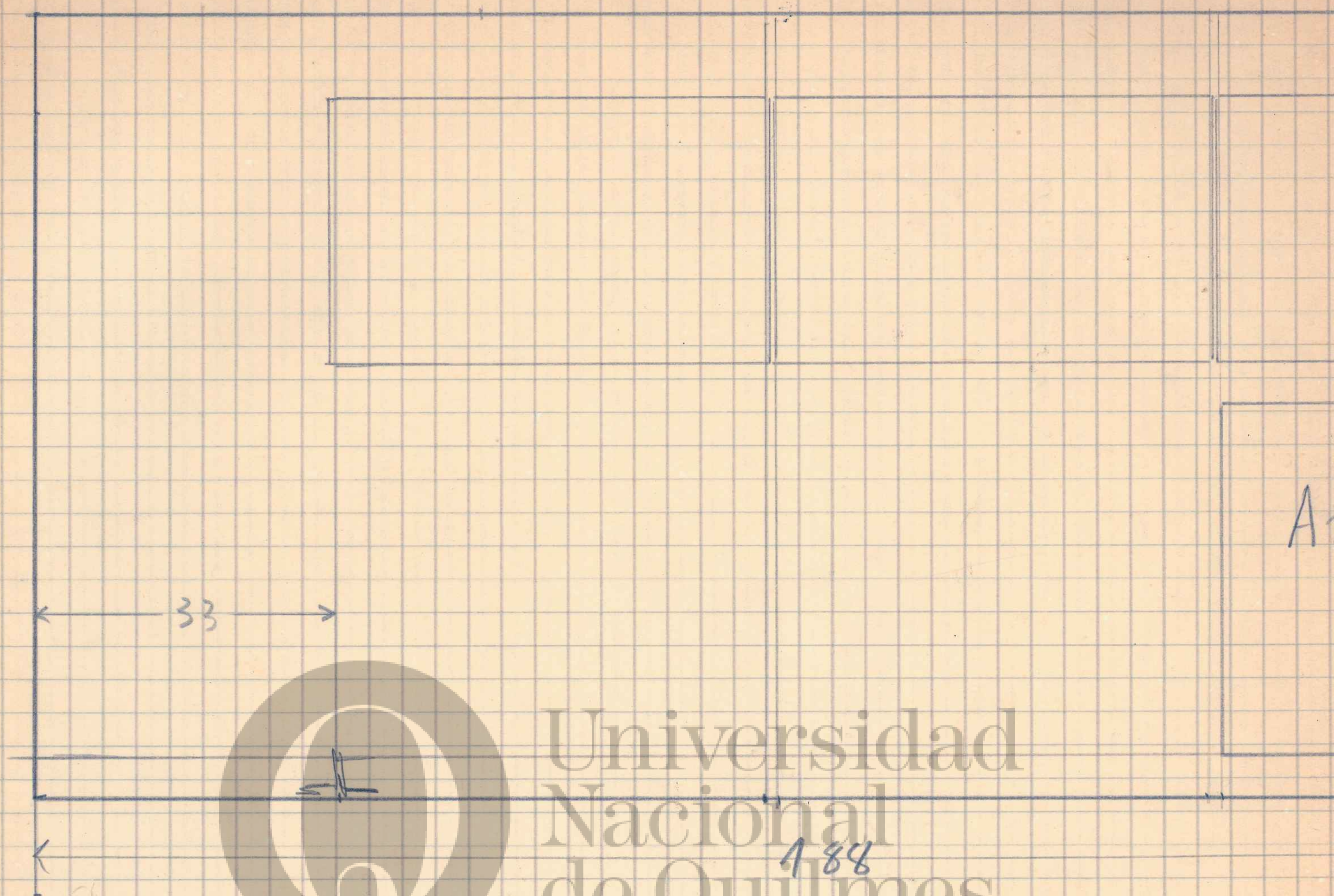
311 colord

311 6or2 prog +2 ΔΔШ

311

222


2,76
x 2,30
+ acuadrate
Ampex M
Ampex M
ex ST
-75

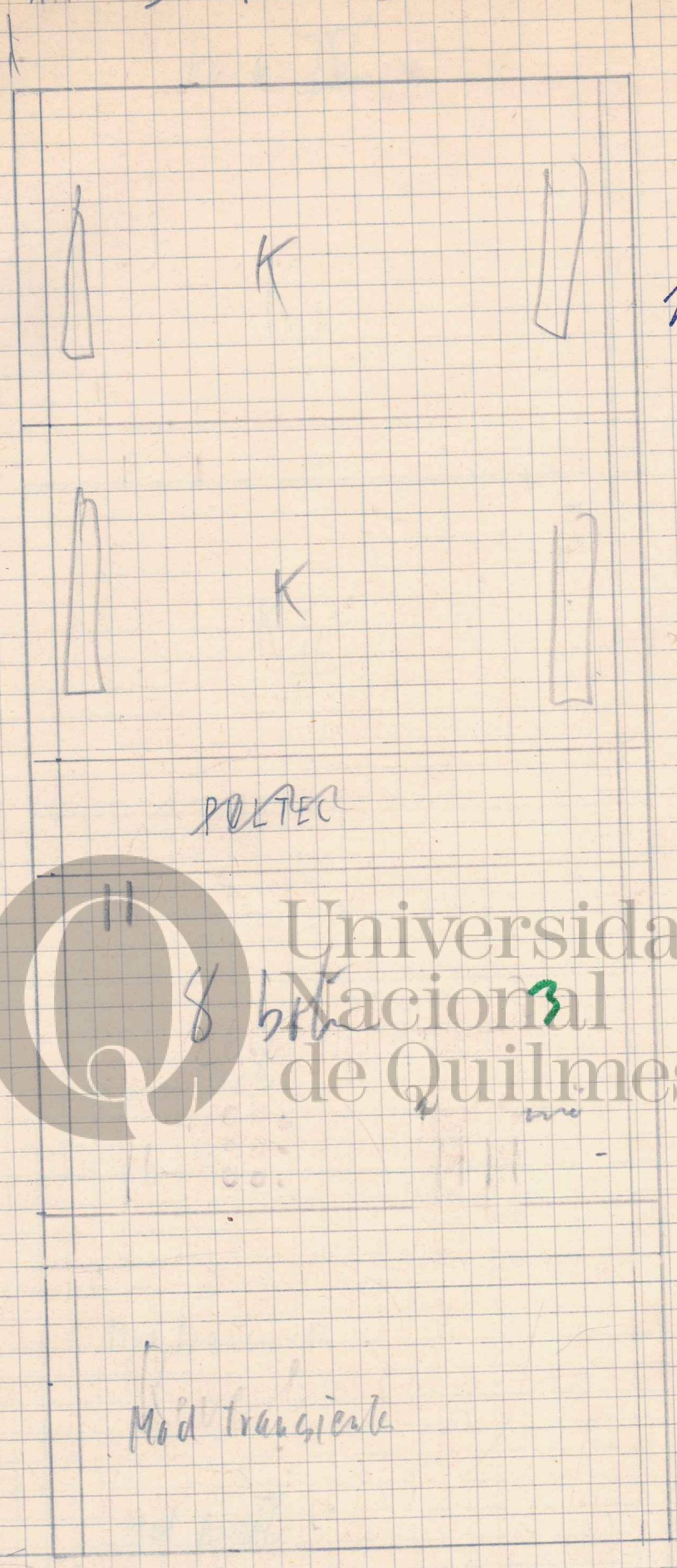

33
188
A

RACK 3 Filtros

N.º ~~6~~ 5

33

26,6

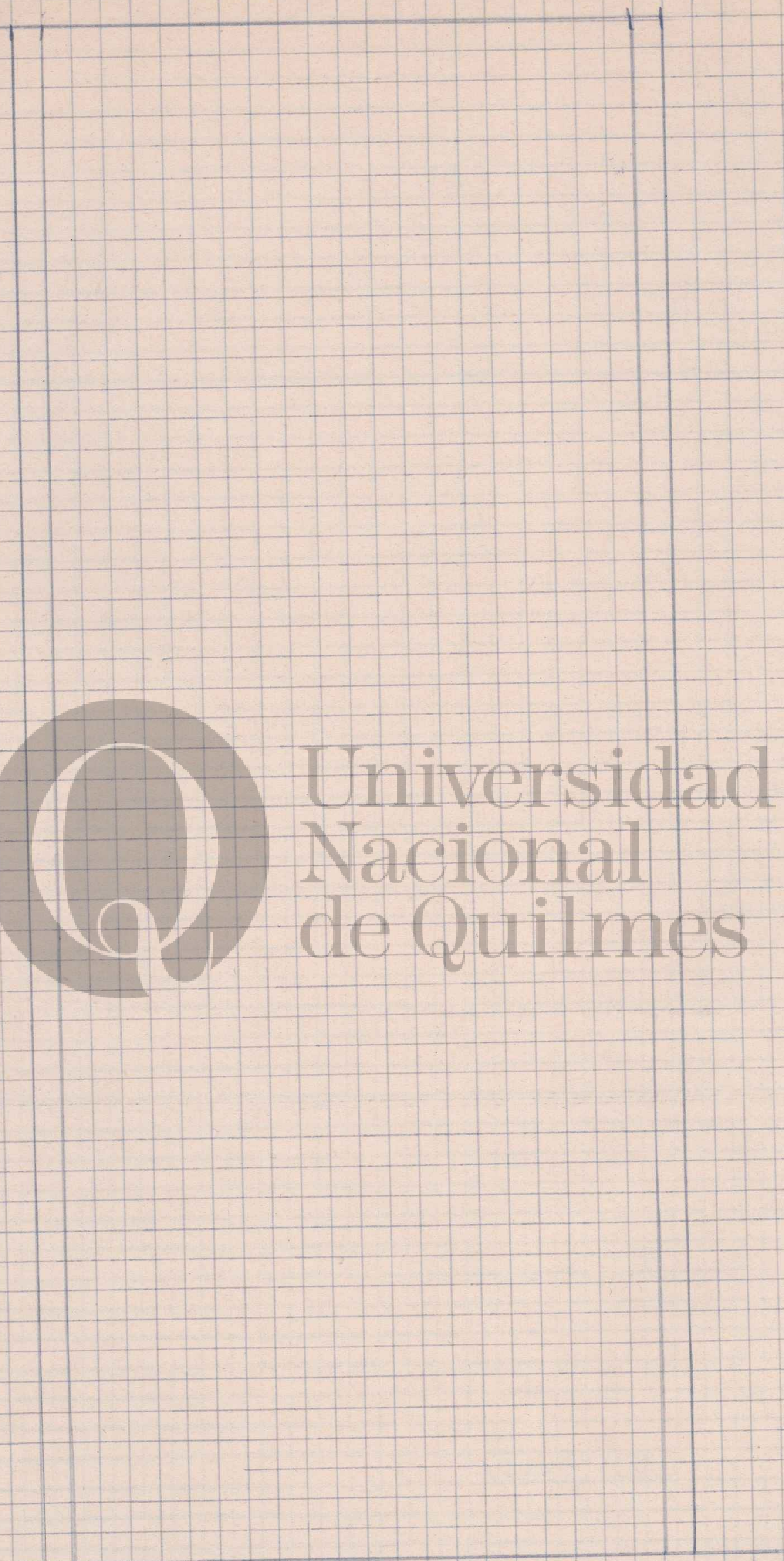


33
12
45 RCA

3 tir terminal 13 c

Rack IV

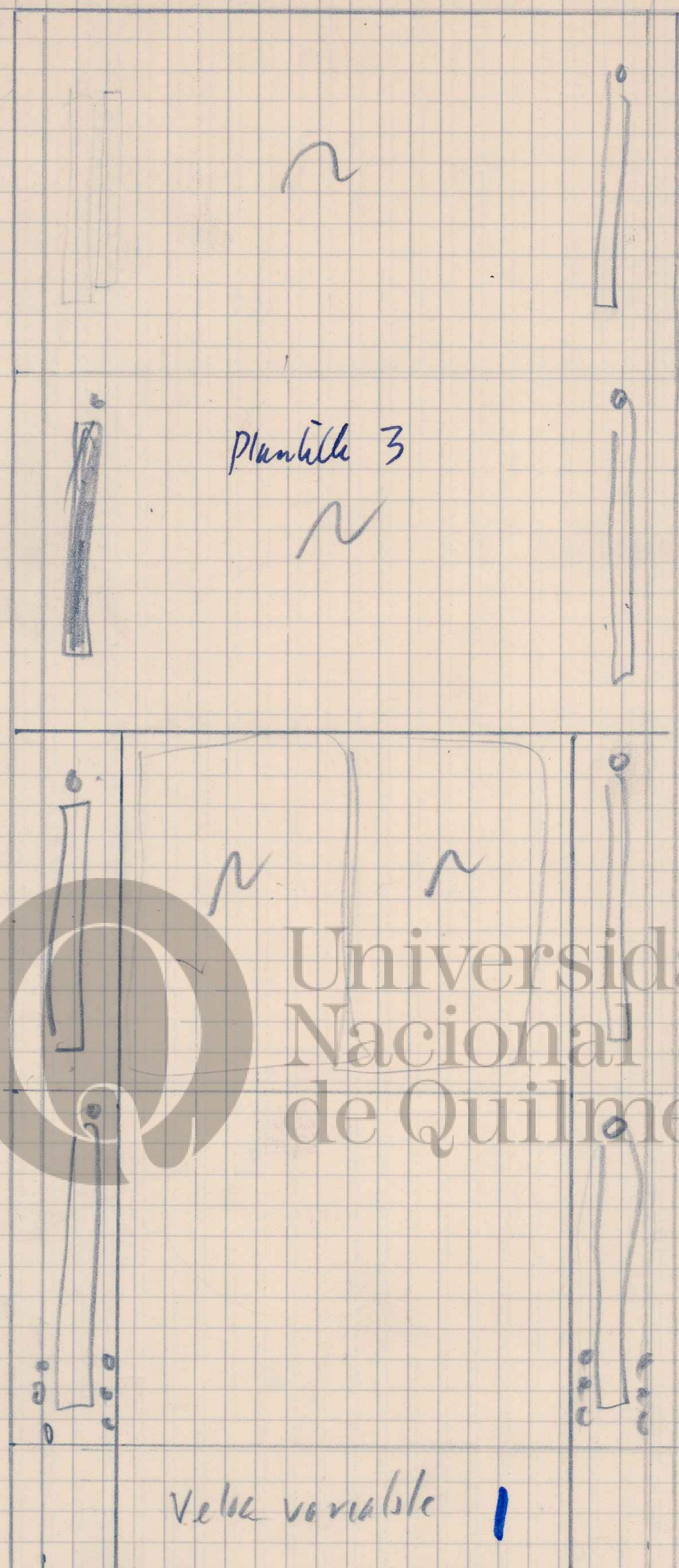
Rack III



Rack IV

Rack 2 osciladores

1:50



33M

49,5

6
30
4x11

44 RCA
+8
52

2 tiras 13e

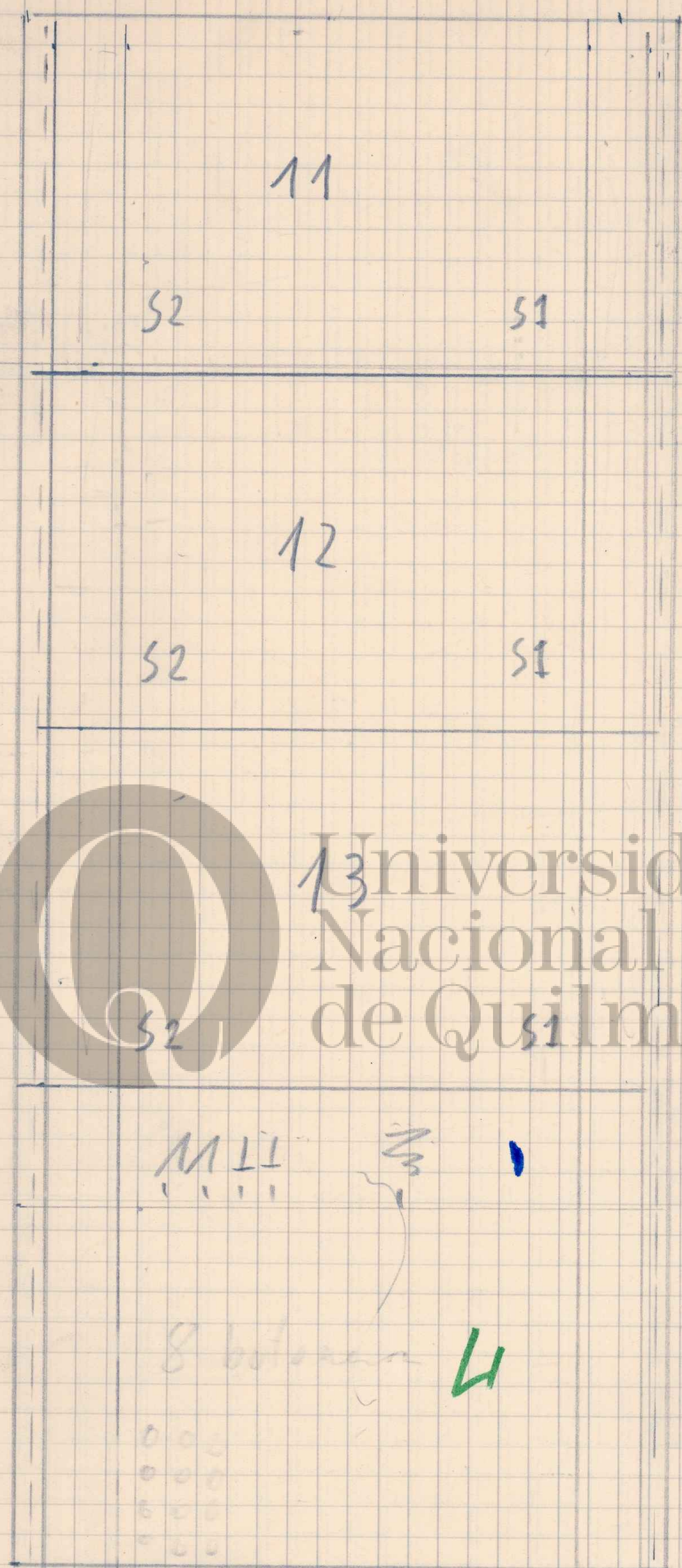
Rack 121
otro rack

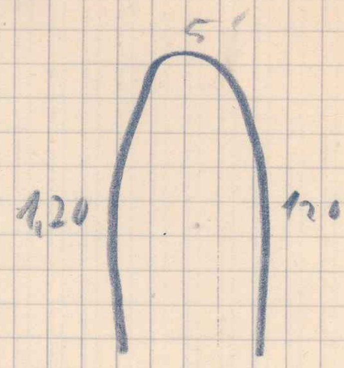
Panel

35 tomas ext 220

1:50

RACK 1 osciladores





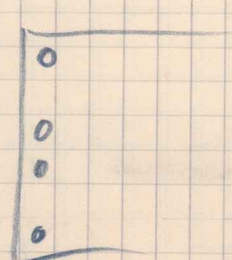
= 3M

X = 33M

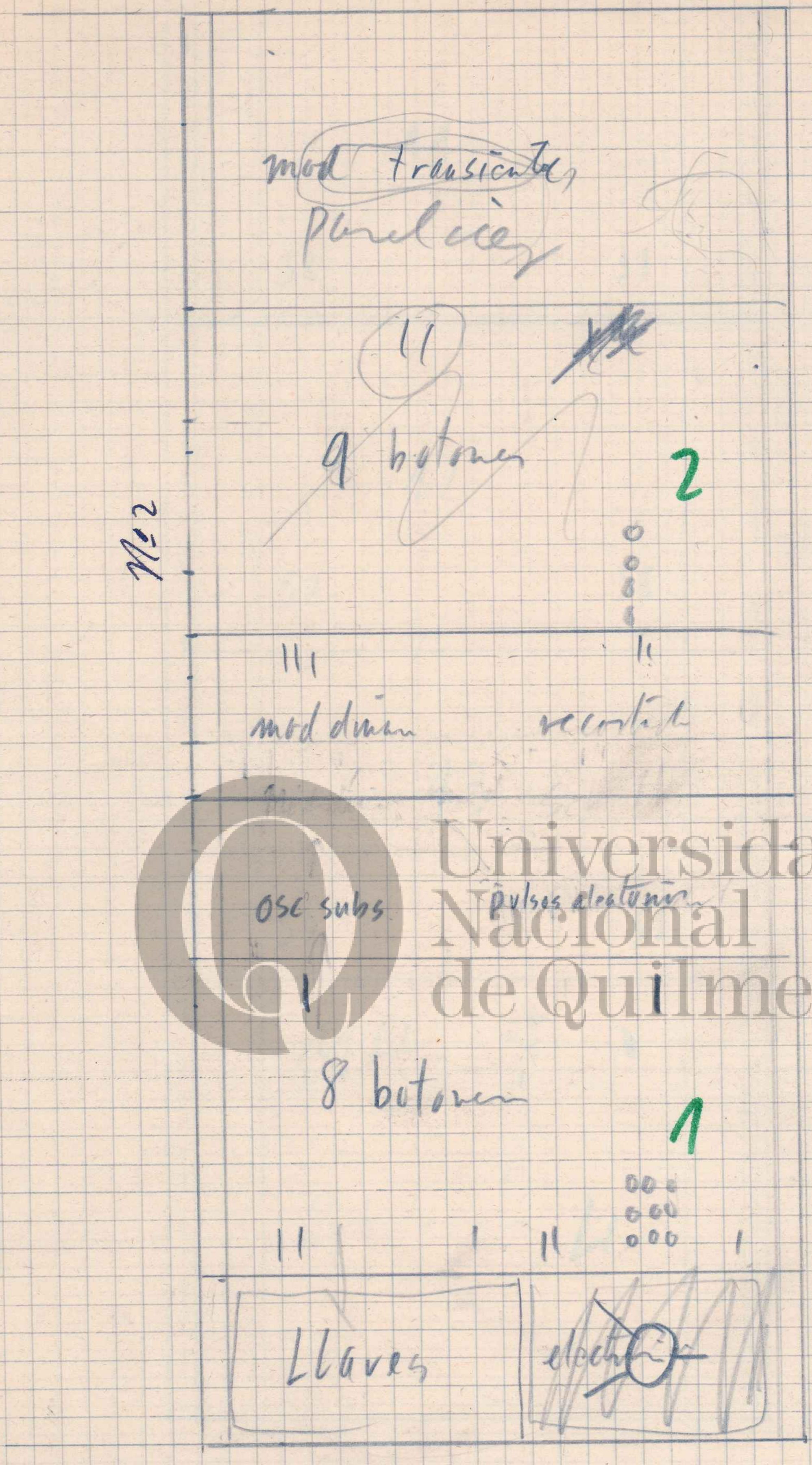
$$\begin{array}{r} 33 \\ +\ 14 \\ \hline 57 \end{array}$$ RCA

2 tiras 13 c

1 panel



Rack 4 Moduladores



22M

24,5
x14

44
16
60

2 tiras 13C

PREPRINT NO. 612 (L-5)

AN ELECTRONIC MUSIC LEARNING SYSTEM

by
Victor J. Blong
C. G. Conn, Ltd.
Elkhart, Indiana

PRESENTED AT THE

35th CONVENTION

OCTOBER 21 – 24, 1968

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AN ELECTRONIC MUSIC LEARNING SYSTEM

By

Victor J. Blong
C. G. Conn, Ltd.
Elkhart, Indiana

ABSTRACT

A new music learning system consists of an instructor console housing a keyboard, intercom, system power supply and tone generators, and visual display showing notes played on any selected keyboard. Up to 24 student keyboards may be used. A student may hear his playing via speaker or headset and see the notes he plays displayed on his music rack.

WHAT IS IT?

The CONN Music Learning System consists of an instructor station and up to 24 student stations, divided into four groups of six stations each. The instructor may monitor the playing of any student undetected, or hold two-way vocal or musical communication between himself and the student. Pre-recorded material may be sent from the instructor station to from one to 24 students, or the instructor may record the playing of the same. The instructor may also see the notes played by any student displayed via lamps on the instructor keyboard's music rack.

The instructor station consists of a mobile console which may store four student keyboards, plus miscellaneous items. The console houses the system power supply, continuously running tone generators, power control panel, intercom panel, and an instructor keyboard with its special music rack (See Fig. 1). An expression pedal is normally used to control the volume of the instructor keyboard, which leaves the hands free for other duties.

A student station consists of a 44-note keyboard covering Notes F_2 to C_6 (See Fig. 2). An amplifier-control section to the left of the keyboard contains several items. A transistor amplifier supplies audio either to a speaker or a headset jack, as selected by a switch. An unswitched auxiliary jack allows a second person to listen in, or can be used as a record jack. A tone switch selects one of four voices. A volume control has calibrated markings from 0 (no output) to 5 (maximum output). An expression control jack at the rear of the unit replaces the volume control when an expression pedal is plugged in, for organ-type training. A Call-Listen-Talk lever lets the student call the instructor in the "Call" position, lighting his lamp on the intercom panel. The lamp remains lit until the instructor answers, letting the student continue with his practicing. Upon receiving voice communication from the instructor, the student answers by switching to the "Talk" position and speaking. The speaker is now acting as a microphone. The switch has spring return from either "Call" or "Talk" to the "Listen" position. The student's music rack may contain lamps which are lit by the keyboard, indicating to the student by help of music signature cards placed on the music rack, whether or not he is playing the right note for that musical key. He may switch the lights from the Bass Clef range to the Treble Clef range of the keyboard, or turn them off. All power and the 44 tones are supplied to the student keyboards from the instructor station via flat 60 conductor polyester cable, which plugs into each keyboard, looping from one keyboard to the next. All keyboards are alike. They may be used in any sequence, yet automatically connect to the proper intercom switch due to an offset in each intercom line as it passes through the keyboard.

WHAT IS ITS PURPOSE?

From the start, the music learning system was not intended to be a "piano" or "organ" teaching device, although such use could be made of it. It was planned to be a compact, relatively inexpensive, multiple keyboard music training instrument for classroom teaching. Colleges, elementary schools, and high schools, as well as summer teacher training workshops, schools for retarded children, or music stores may all make use of the device. Some of the areas in which it may be used are as follows:

1. General music training for young children, accompanied by singing, autoharp, recorder, bells, etc.
2. Vocal music training.
3. Composition, harmony, arranging, theory.
4. Sight reading
5. Organ and piano keyboard instruction.
6. Teaching elementary school teachers general music courses.
7. Music therapy.

Pilot projects have been using the system since June, 1967, two years after its development cycle was begun. Fig. 3 shows one of the projects using an earlier 37-note keyboard with its control panel on the right end.

HOW DOES IT OPERATE?

One of the most efficient classroom layouts uses two 16-foot rows of tables arranged in front of the instructor's console, as shown in Fig. 4. Classroom space is minimized and all interconnecting cables are hidden, except for the feeder cables from the console, which may be covered with a carpet runner.

The block diagram of the complete system (Fig. 5) shows a tone generator-line driver section which feeds signal to the instructor keyboard and all the student keyboards. The student keyboard lights its music rack lamp display, indicating which notes are played. The instructor may listen to, speak to, or play for a student through the intercom panel. He may also, by a light display switch, select a student keyboard to turn on lamps in the instructor music rack lamp display via dc applied to the 44 signal lines by the student keyboard. He may do the same from his own keyboard to see the notes he is playing. A more detailed description of the various system blocks follows.

A. TONE GENERATOR-LINE DRIVER

In the block diagram (Fig. 6) the sine wave output of a Hartley Oscillator is fed into a squaring circuit for each of the top 12 notes. The output of the squaring circuit then divides into two paths. One enters a line driver switching amplifier which switches between fully on and fully off. This can be used because the signal is a square wave. Outputs to the lines are essentially 18V P-P square waves at low impedance. The second leg of the squaring circuit output is fed to a divider driving amplifier, isolating the trigger signal from the loading effect of the output lines. Dividers utilize dual in-line integrated circuit packages. The output of each divider is transmitted to a signal line by another line driver amplifier. A capacitor gives the line dc isolation, to allow it to perform an added switching function which will be described later.

B. STUDENT KEYBOARD

Outputs of the line drivers are coupled into 60 conductor flat Mylar cable, along with intercom and power lines, via a set of junction boards. At the student keyboard (Fig. 7) each note goes to a key switch through an isolation resistor. When a key is depressed, the signal is transferred to the signal rod, and from the rod goes to the voicing circuits through a dc isolation capacitor. Voicing is followed by the volume control, preamp, and power amplifier to either the speaker or headset as selected by the speaker-headset switch.

An intercom line connects the student to a switch on the intercom control panel at the instructor console. The instructor may choose to listen to a student. Music played by the student, after passing the preamp, goes through a dc blocking capacitor to the Call-Listen-Talk switch (See Fig. 8), normally in the "Listen" position, and is applied to the student's intercom line. By switching to that intercom line, the instructor then hears what the student is playing, undetected by the student.

When the student wants to communicate with the instructor, he switches to "Call", connecting the intercom line to ground in his keyboard and lighting his lamp on the intercom panel. The instructor may then respond, and the student hears him in the "Listen" position of the switch. The message from the instructor travels from the intercom line, through the Call-Listen-Talk switch into the power amplifier, from there into the speaker or student's headset. When the switch is held in the "Talk" position, the speaker is disconnected from the amplifier output and connected to the input of the preamp, becoming a microphone with quite good sensitivity.

A separate set of light keying rods allows 18V dc to be keyed, lighting lamps on the music rack corresponding to the keys played. Punched holes in music signature cards hung on the music rack indicate the proper notes to be played for a given musical signature. Each black key lights two lamps, one corresponding to a sharp note, and one a flat, which places the two at different heights on the signature chart. Lamps lit by incorrect notes still light, but are covered by the charts.

The rod dc switch circuit is a device which allows the instructor to see the notes played by a student displayed on the instructor's music rack. This will be explained in greater detail later.

C. INSTRUCTOR KEYBOARD

The instructor keyboard is identical to the student's, except for the music rack. Since the instructor uses the headset and microphone on the intercom panel, he does not need to use the similar functions provided by the keyboard. These sections are shown dotted on the instructor keyboard diagram (Fig. 9). His music rack is larger, using one lamp (or pair of lamps in case of the black keys) for every tone generator signal distribution line over the range of notes covered by the music rack. It includes a dc switching circuit for each lamp, activated by a key on any student keyboard the instructor selects via the intercom panel. By this means the instructor may see if the student is playing correctly. Operation of this system will be described in detail later.

D. INTERCOM

Communication between student and instructor, monitoring the student's progress, sending program material to the student, or recording the student's efforts are all functions of the intercom system. The control panel (Fig. 10) is laid out in four groups of six students each, similar to a classroom. A group switch, at the top, will connect all six students in that group to the instructor. If communication with all 24 students is desired, then all four group switches are used. If one or more individual students are wanted, then any combination of the 24 individual instruction switches may be used. Or, Student A-3, all six of Group B students, and Students

D-4 and D-6 may be contacted at one time by using the appropriate switches. The system is very flexible. Call lamps are to the right of each individual student switch. The call lamp will remain lit until the individual's switch is turned on, toward the lamp, keeping the call on "Hold" until answered. Card strip holders are provided to place student names under their switch and lamp, if desired. The instructor's Send-Receive switch is at the bottom, nearest him, for ease of operation.

Fig. 11 may be used to describe the operation of the system. A power amplifier accepts inputs from a microphone and its preamp, a high level input jack, the instructor's keyboard, or from the preamp on the keyboard of one or more students selected through the individual or group switches and through the Send-Receive switch in "Receive" position. Output of the amplifier supplies signal to the delayed turn-off circuit to keep the whole system turned on, also feeding the record jack and instructor's headphone jack.

With the Send-Receive switch in "Send" position, the amplifier output is sent to one or more students selected by the individual or group switches. Also, when the Send-Receive switch is in its "Send" position, dc voltages are applied to "turn on" diode switches which connect any selected individual student(s) directly to the output of the power amplifier. When a group switch is turned on to send to a group, the same dc voltages are applied through a section of the switch to a second set of diode switches, connecting that group of six students directly to the amplifier output.

When the Send-Receive switch is in "Receive" position, incoming messages on the student intercom lines may be switched in, via individual or group switches, passing through the isolation resistors into the power amplifier via the Send-Receive switch, allowing the instructor to hear them. Isolation is required in this case to prevent tying student keyboards directly together by the intercom switches when listening.

E. DELAYED TURN-OFF

The before-mentioned delayed turn-off circuit keeps the entire system operative so long as activity takes place anywhere within the system, either by students or the instructor. After about seven minutes of inactivity, the system turns itself off automatically, protecting itself from being left on over a week-end or vacation period. The feature is more for peace of mind than anything else, due to the low power consumption of the system. The seven-minute period resulted from practical circuit component values chosen for reliable operation. If cut-off is chosen too far out on the exponential RC decay curve, it becomes erratic, and may not cut off at all. According to the educators consulted, seven minutes of inactivity during a class period is wasting time.

Signal voltages from the intercom amplifier and incoming student intercom lines are amplified, rectified, and stored on a low leakage tantalum capacitor. A long RC time constant decay path is provided. The dc voltage is applied to a solid-state switching circuit, which in turn controls a relay coil, closing the line voltage contacts. To start the system initially, the Start-On-Off switch closes a parallel set of contacts, and applies a dc voltage to the storage capacitor from the power supply.

F. OPERATION OF THE INSTRUCTOR'S MUSIC RACK LAMP DISPLAY

One of the more complex circuits in the music learning system is that which allows the instructor to see the notes played by any student displayed on the instructor's music rack. The feature can be extended to a large visual display for the whole classroom. Multiple use is made of intercom lines and tone generator signal lines to keep the total number of lines down to a minimum.

Operation of the system might best be explained by having the instructor turn on the student lamp display switch at the instructor console. The switch circuit is located near the top center of Fig. 12. Positive 21 volts is applied to a contact in each individual and group switch through an RC filter to remove ripple. When an individual (or group) switch is turned on, the dc voltage is applied to the student keyboard on its intercom line. All paths adversely affected by the dc voltage are blocked by capacitors.

At the student keyboard the +21V dc is applied to the rod dc switch, a Schmitt trigger circuit, which applied a dc voltage to the rod of approximately +15V magnitude. When the student plays a note, the key finger transfers a positive dc potential to the tone distribution line at the same time it is transferring the tone to the rod. The increased dc potential on the line is common to the entire system, so reaches the lamp dc switch circuit on the instructor music rack. A capacitor blocks the dc from the tone generator-line driver section. The lamp dc switch is another Schmitt trigger circuit. As long as the positive dc potential is applied to its input from the tone distribution line, it turns on the lamp(s) on the music rack corresponding to that note. Remember that black keys turn on two lamps, a sharp and a flat. The instructor may use the student musical signature charts, or a special grand staff chart which covers both bass and treble clefs.

When the instructor wants to see the lamp display keyed from his own keyboard, he turns on the instructor lamp display switch on the console. The +21V dc is applied to the Schmitt trigger circuit in his own keyboard, applying a positive voltage to his own signal rod. From there on, the operation is identical.

CONCLUSION

From the start of the development cycle, objectives of the CONN Electronic Music Learning System have been as follows:

1. Provide a relatively portable, compact system.
2. Use sustained tone from a central set of continuously running tone generators.
3. Allow a flexible setup which can start with a small system, if necessary, and add units as the need grows.
4. Meet a need in general musical education as recommended by the consulting music educators.

Exposure of the system has been carefully controlled, up until now, awaiting instructional material to go with it. It is in the pilot projects that such "software" has been, and continues to be, worked out, using experimental music classes in public schools to do so. Acceptance by educators using the system has been very good. Fifth grade children have even come back voluntarily on their own time to practice on the keyboards, showing a great deal of interest. It is believed that the system is ready to take its place in institutional music education.

I wish to thank my co-workers at C. G. Conn, Ltd., J. S. Southard, who started the project, and L. R. Shallenberger, who is responsible for most of the CONN Electronic Music Learning System circuitry, as found in its present form.

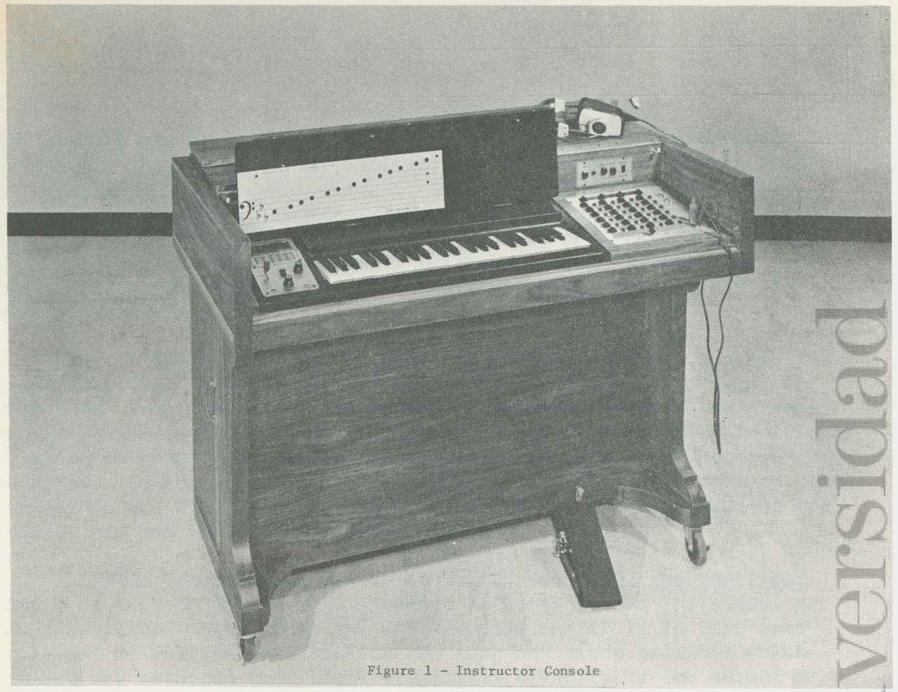

Figure 1 - Instructor Console

Figure 3 - Music Learning System Workshop

Figure 2 - Student Keyboard

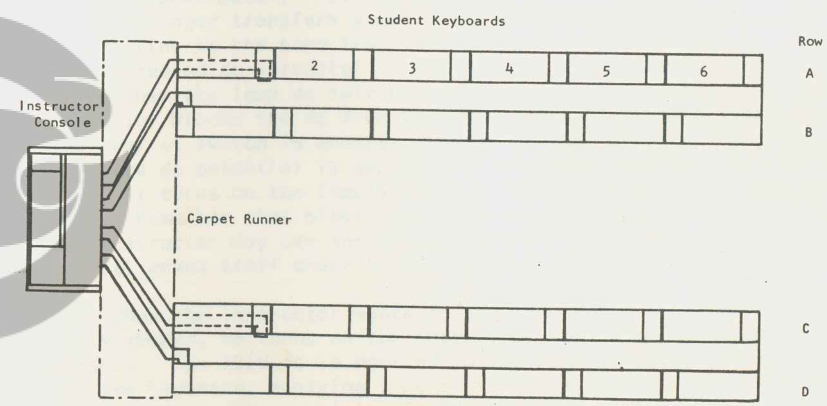

Figure 4 - Typical 24 Unit Class Setup

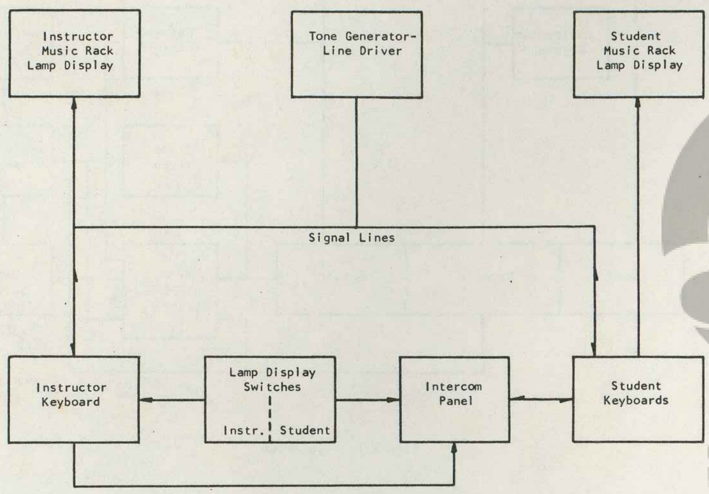

Figure 5 - System Diagram

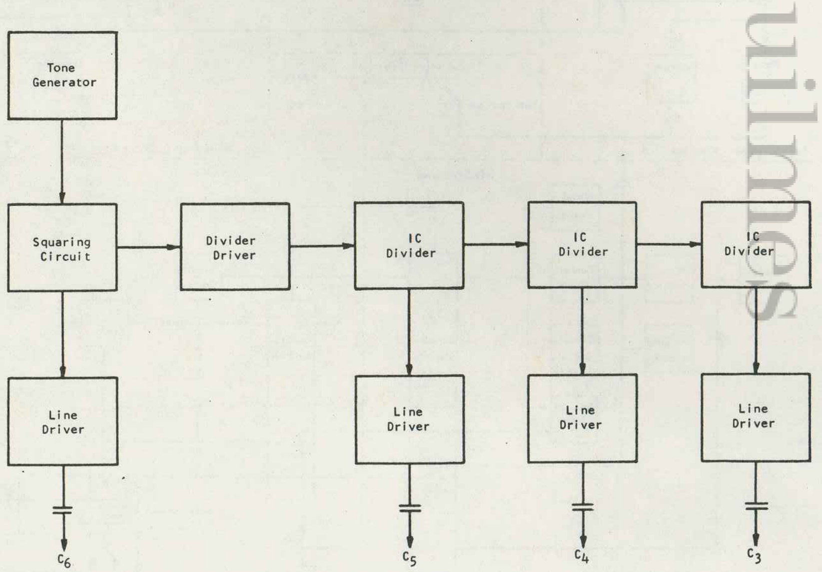

Figure 6 - Tone Generator/Line Driver

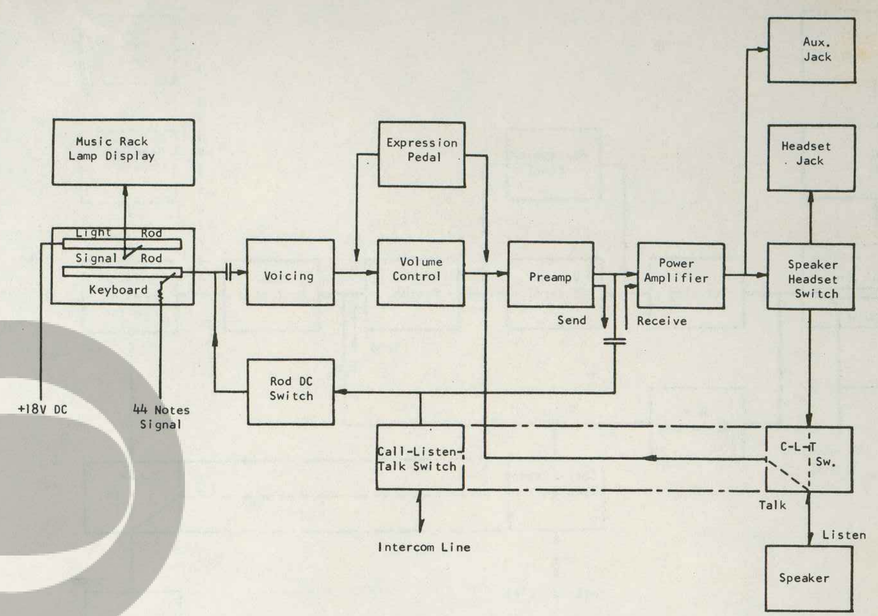

Figure 7 - Student Keyboard

Figure 8 - Student Control Panel

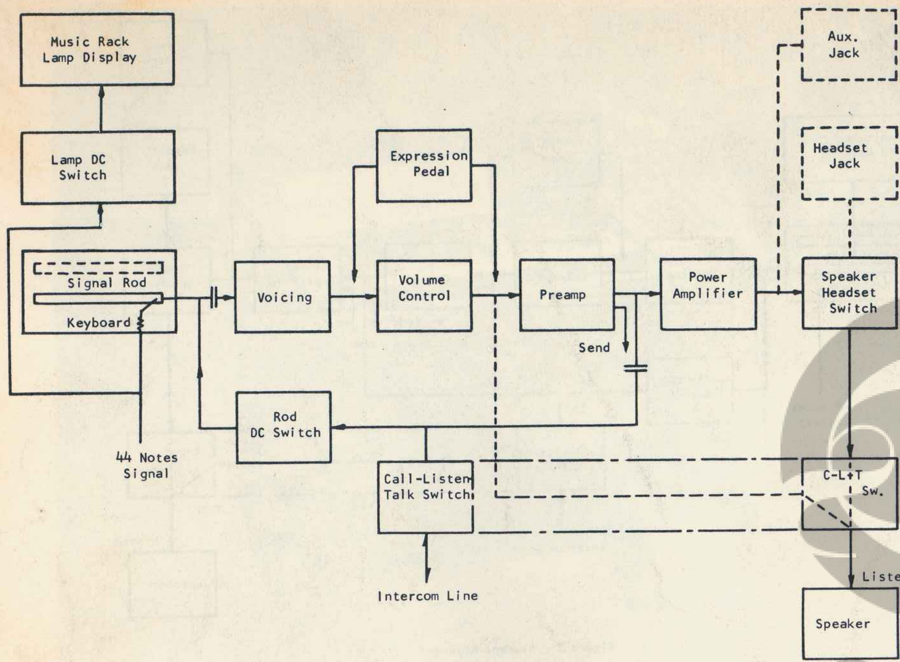

Figure 9 - Instructor Keyboard

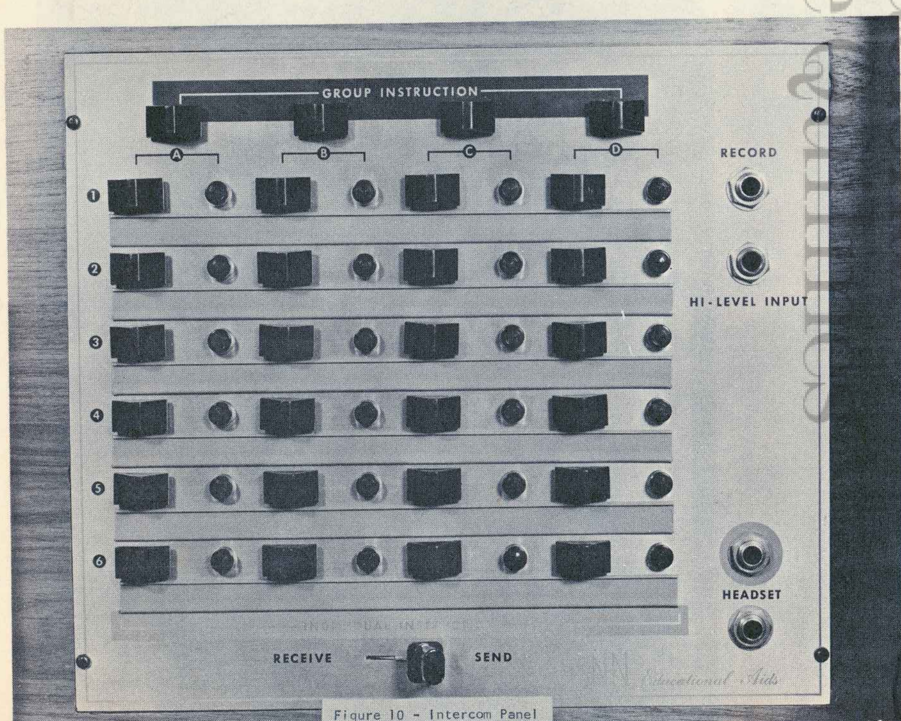

Figure 10 - Intercom Panel

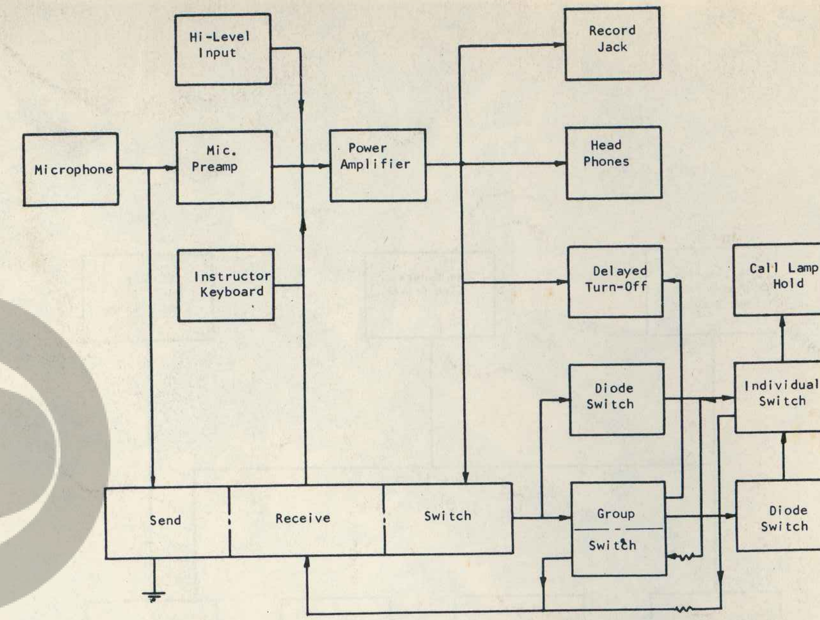

Figure 11 - Intercom

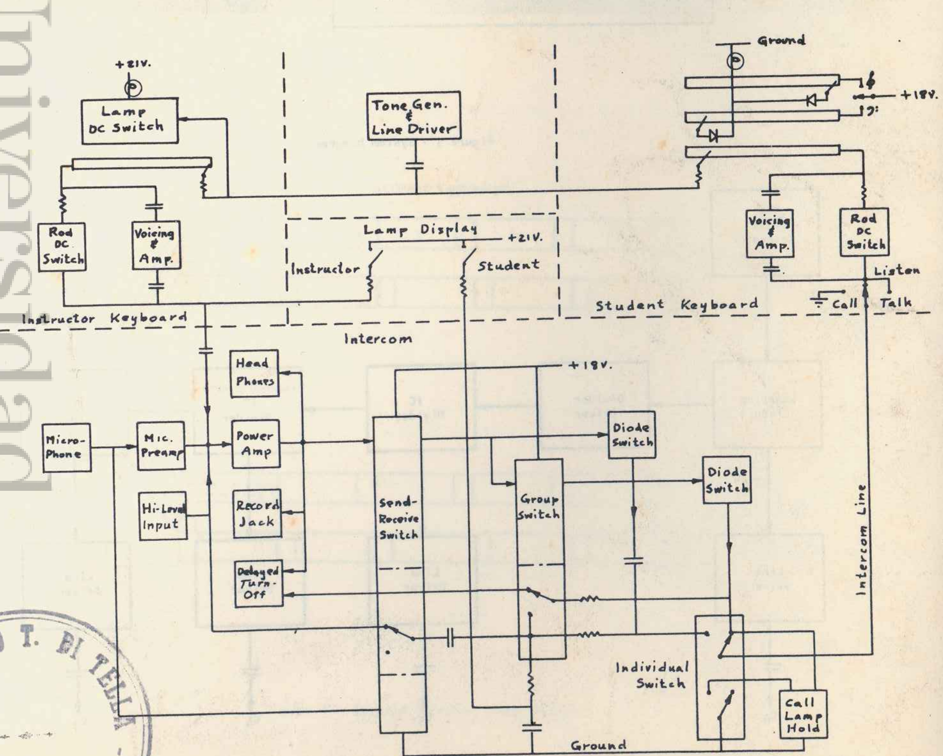

Figure 12 - Operation of Instructor's Music Rack Lamp Display

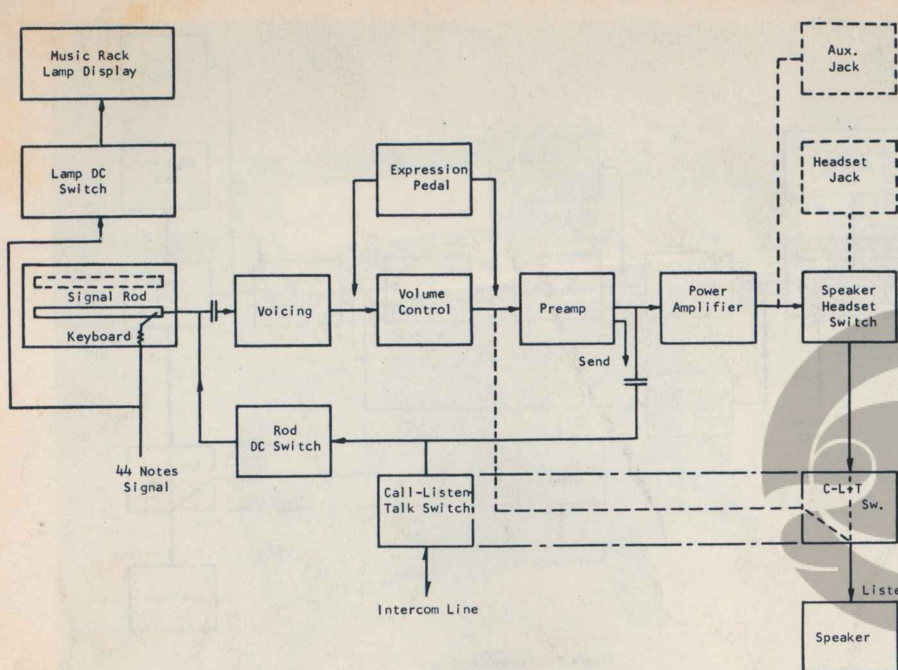

Figure 9 - Instructor Keyboard

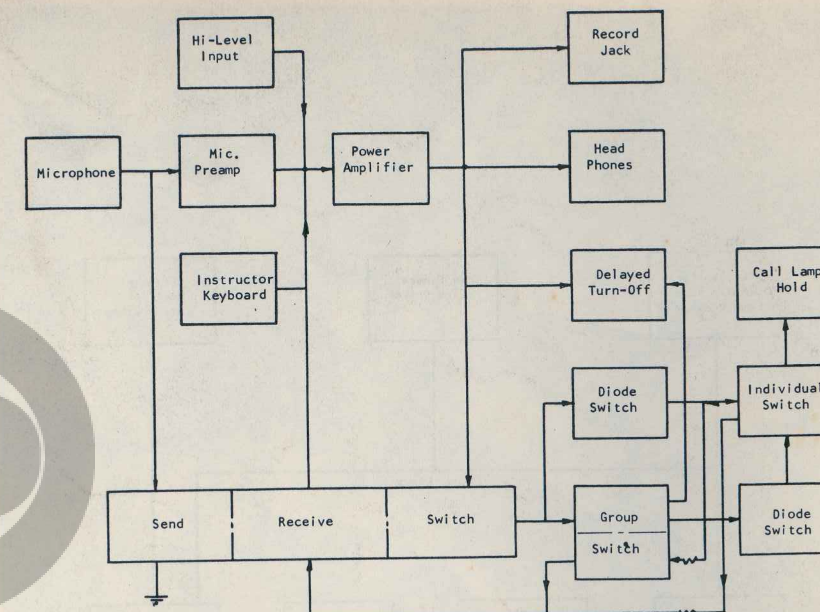

Figure 11 - Intercom

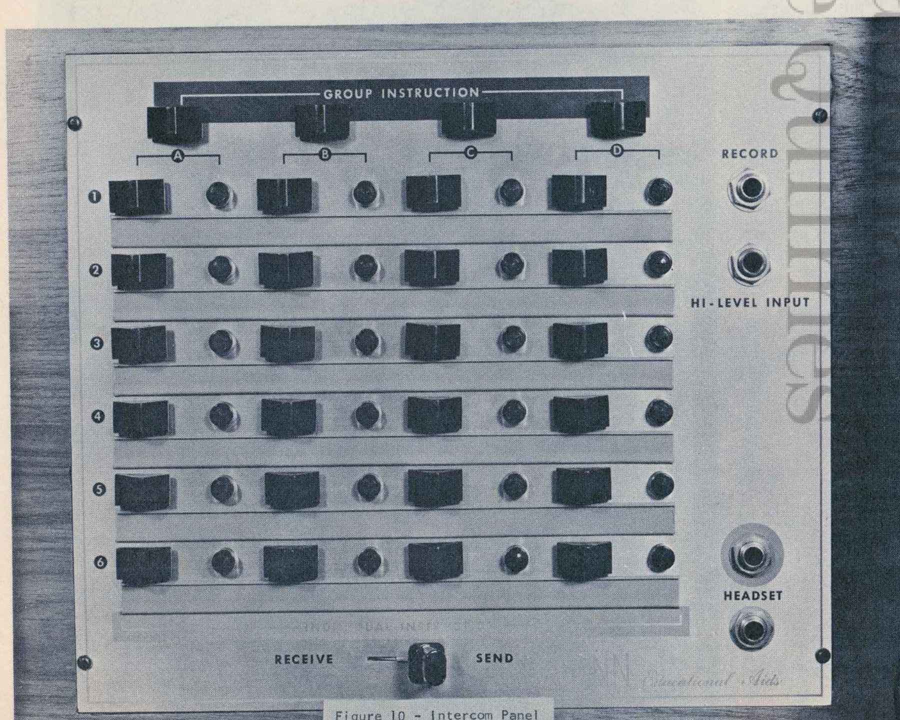

Figure 10 - Intercom Panel

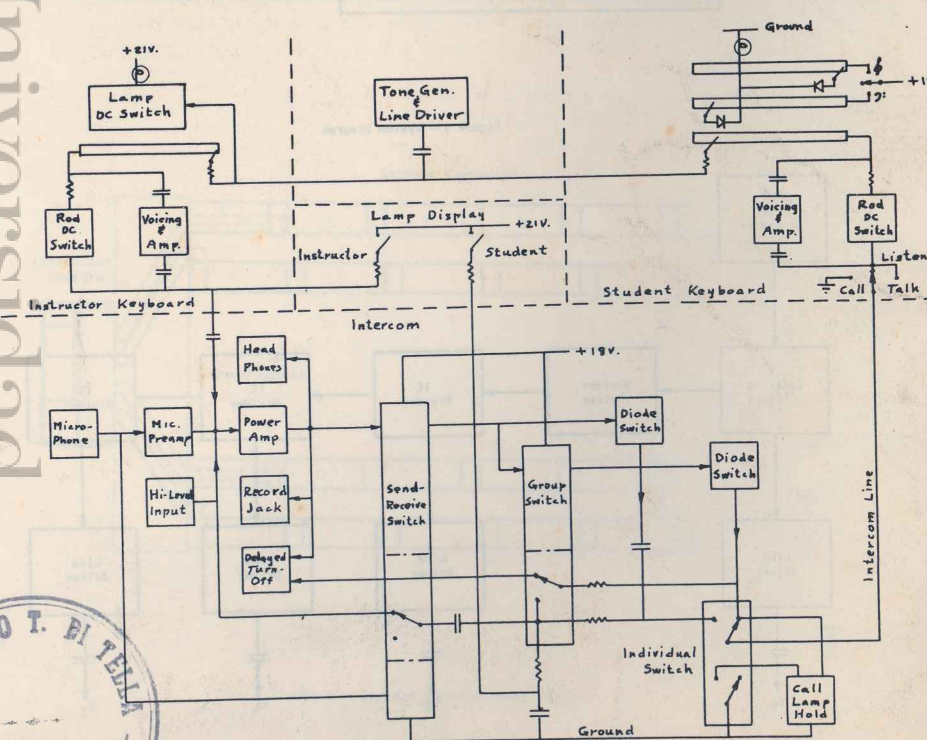

Figure 12 - Operation of Instructor's Music Rack Lamp Display