S U Z A N N E C I A N I

REPORT TO NATIONAL ENDOWMENT

RE: COMPOSER GRANT

June 1976

Following is an outline of a "Basic Performance Patch" which I designed for a Buchla Series 200 instrument, and a brief description of some of the musical ideas that evolved as a result of working with this patch.

For the sake of clarity, I give each of the musical ideas a distinct and descriptive name: "Keyboard Rotations," "Melodic-Rhythmic Reliefs," "Vertical Sequencer," and "String Patch." The first three of these are concerned primarily with permutations of given ordered sets of pitches, accomplished either by means of the sample and hold of the polyphonic keyboard, or by means of a matrixing of the sequencer rows by the AFG: (Multiple) Arbitrary Function Generator. The "String Patch" illustrates a completely different use of the AFG.

Also given are step by step examples of how to go from one of these ideas to another in a performance situation. These are only rough maps, but they do illustrate the characteristic facility for musical metamorphosis that the instrument possesses; and they also show the kind of playing technique that one has to develop for live performance. In the practiced performer, a kind of instinct comes into play, and making a transition from one musical idea to another is almost a matter of reflex -- and somewhat difficult to describe in detail.

Also given are a few techniques for rhythmic improvisation, which I generally keep for the "climax" of a performance, and some techniques for discrete spatial rhythms.

I find that the best performances combine the competence of pre-planned and well-rehearsed playing with the magic of being able to follow one's inspiration when inspired by the audience and the moment. To do the latter, a performer must be familiar with his patch to the point of not having to "think twice" (at least not more than once) about what effect or series of consequences will be produced by a given action.

The "Basic Performance Patch"* outlined describes the fundamental signal and control voltage routing for a patch which I have used in performance. The following is a general survey of features of this patch and the considerations taken in designing it.

The signal sources are primarily two oscillators, with a third oscillator available for the part of the performance called "Keyboard Rotations" (described later), and a white noise source used mainly in the percussion improvisation. One of the frequency control voltage inputs of each of oscillators 1, 2 and 3 is controlled by the keyboard -- all tuned in unison, diatonically. Oscillators 1 and 2 are also frequency controlled by the AFG 248-1602 outputs 1 and 2 respectively, so that the limited range intervals are octaves. These two oscillators are also controlled, via the AFG "external" mode, by the 246 16-stage sequencer.

The AFG in "external" mode and the sequencer are a powerful combination for pitch control. First, the AFG allows quantization of the sequencer voltages via the "quantize" mode of the AFG, for easy setting of pitches. Note that the first stage of each sequencer row is set at the lowest note of the row, or "0" volts, to provide a tuning convenience as well as a stopping position in order that the keyboard can take over as sole pitch controller. (To take advantage of this, a single pulse from the subsection of the keyboard can be assigned to both stop the sequencer and select stage 1.) Second, the AFG allows a

* - See Diagram 1

totally flexible matrixed access to the sequencer voltages, horizontally, vertically, and obliquely, and the rows have been designed with that consideration: to work in any direction and combination, melodically, harmonically, and contrapuntally.** Third, the AFG allows instant octave transposition of any row or any part of any row.

The rhythmic possibilities of this combination will be discussed later.

All of the oscillators are routed directly to a matrix mixer, oscillators 1 and 2 detouring as well through a frequency shifter. At times in the performance when oscillators 1 and 2 are tracking at a unison or an octave, the frequency shifter provides a timbral enrichment, as in the "String Patch," for instance, which we will look at later. At other times, non-harmonic sonorities are produced, which I use percussively. (In some cases, I can get an immediate cue as to whether the two oscillators are on the same stage of the AFG, being able to display visually only one at a time, because of the dramatic difference between shifted unisons or octaves and any other intervals.)

All of the signals are routed through a matrix mixer for distribution to any of three filters or no filter. Since the filters are tied to gate positions, selection of a filter also selects a gate. The envelope control for the gate is a quad V.C. 284. In a performance,

** - See Musical Illustration 1

I choose freely among trigger sources for each envelope by having at least three banana patch cords already plugged into the pulse input, and then making the connection to the pulse output of the AFG, sequencer, or keyboard -- or looping back to the envelope pulse output -- depending on the needs of that part of the performance. In general, with this patch, I use the pulse outputs of the AFG series 1 and 2 because of the rapidity with which they can be programmed or "played," and because of the rhythmic possibilities and combinations available. Sometimes no envelope is used, the gate simply opened. For quick variation of the envelope, I bridge all of the control voltage inputs and route an offset voltage from the 256 Adder (which gives me the option of adding in other or varying control voltages as well). This one offset voltage allows me variously to shrink or expand any envelope very quickly in a performance, the direction and amount individually controlled by each of the four control voltage input knobs.

Finally, the signals are routed to a spatial locator and then out to four amplifiers and four speakers. (Use of a voltage-controlled reverb is optional.) I consider the spatial characteristics -- where a sound is placed and the way it moves -- to be an integral part of the music, and I plan and "play" the space of each part of the performance. In the future, I expect that this will be one of the most refined aspects of electronic music; but given the present state of electro-acoustics and the deficiencies of performance halls in this regard,

I find it most effective to use clearly delineated types of spaces such as the following:

1. A continuous curved space. I use a slow continuous curved space for the "String Patch," the arc related to the "bowing" envelope.

2. A discrete spatial rhythm. (Please see the graphic description.) In this type of space, the sound comes very precisely from one speaker at a time, the duration in each speaker precisely controlled. Two features of this type of space are: firstly, continuous tones can be given rhythmic impulse defined solely by spatial placement (I use this with sequencer Row A alternate, for instance, where there is little melodic rhythm); and secondly, there is no masking effect for the audience since the sound is completely in only one given speaker at a given instant.

3. A random discrete location. In percussive passages, I route the trigger pulses to a 265 stored random voltage source pulse input and drive the X and Y C.V. inputs of the 227 with the resultant control voltages.

4. A continuous random space. Use the 265 continuous random voltage source.

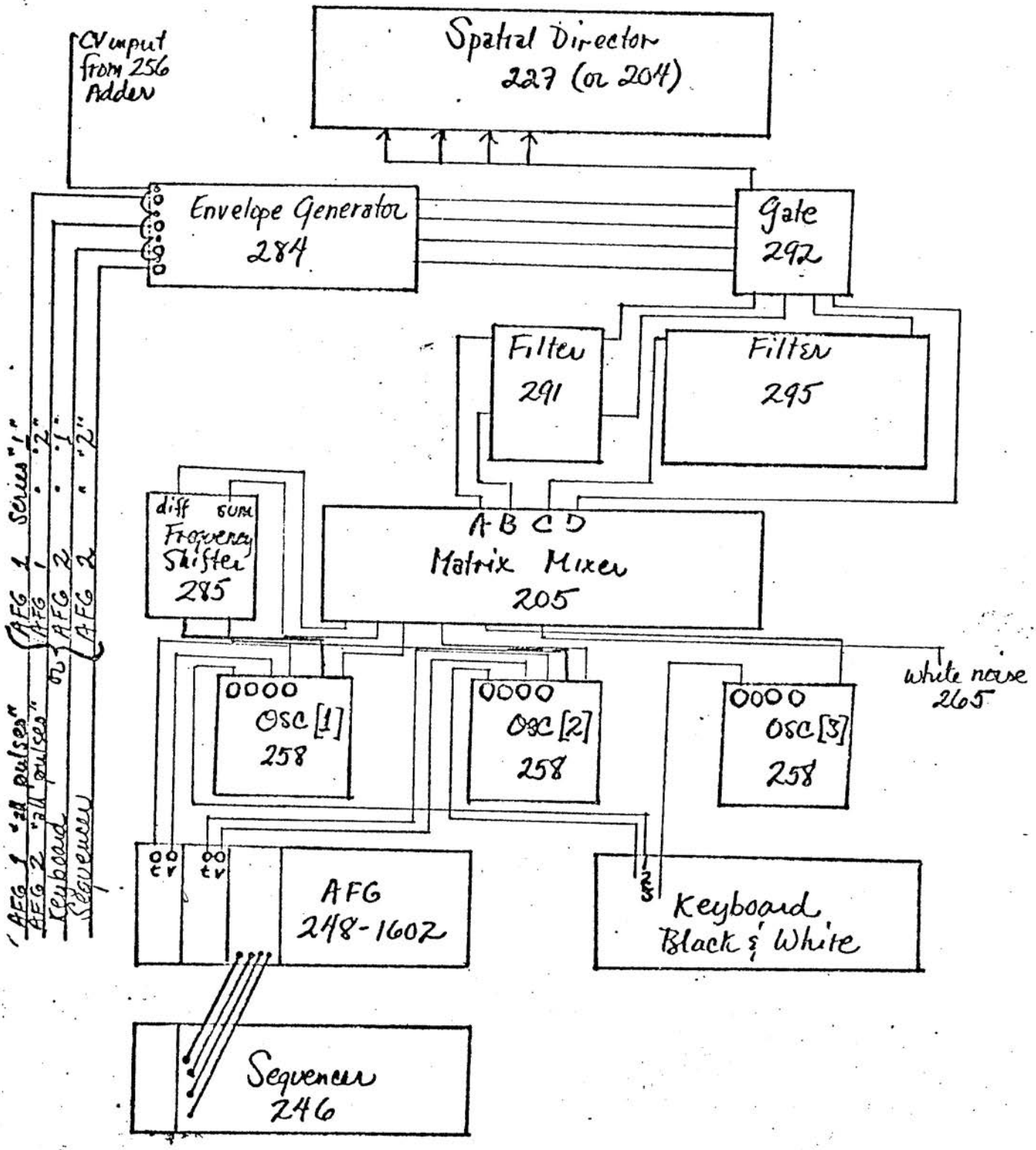
5. Any combination of the above. I think of these as spatial phrases or sentences, and find the 257 Dual Control Voltage Processor very useful.

Diagram 1

BASIC PERFORMANCE PATCH

BASIC PERFORMANCE PATCH

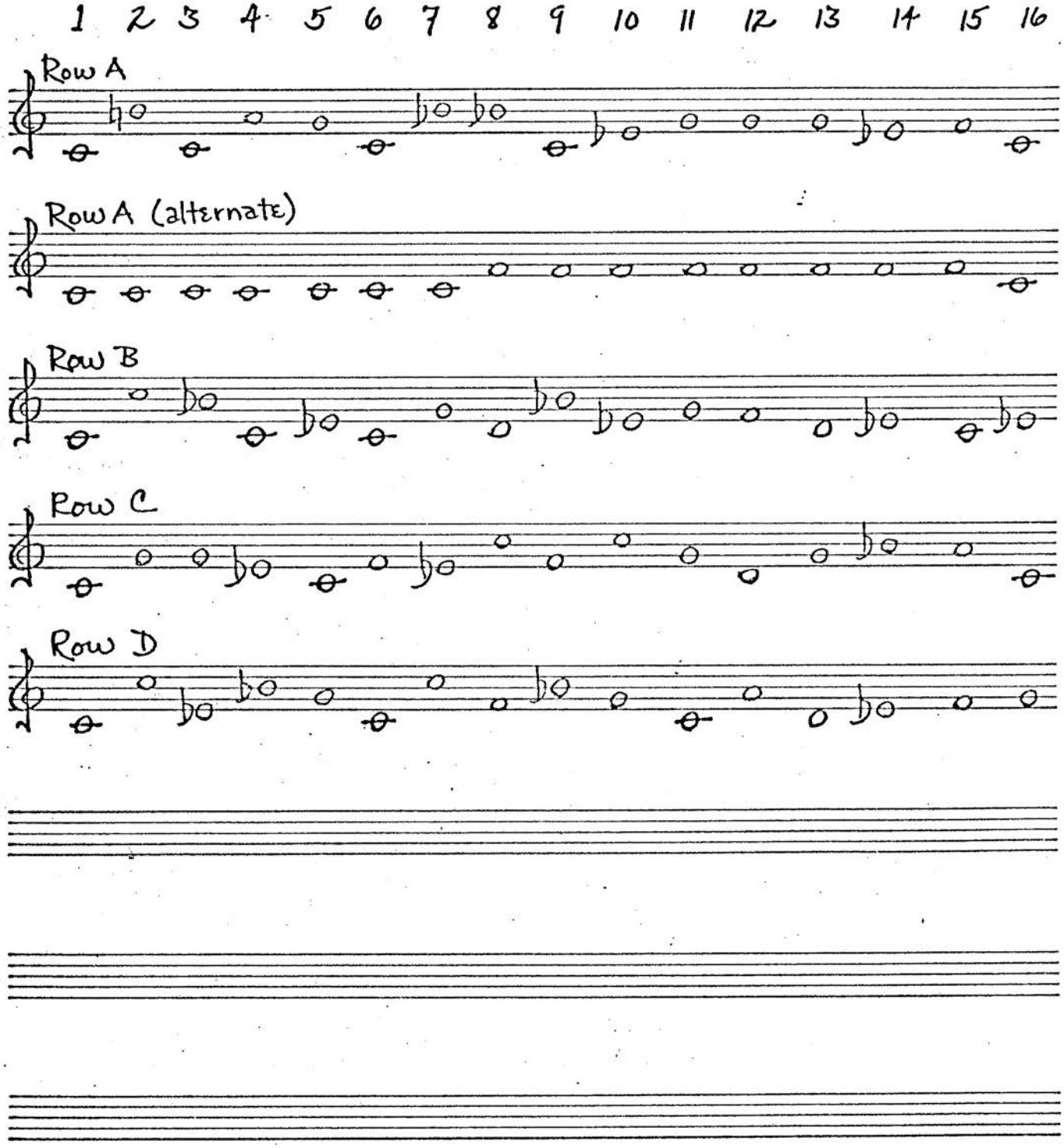
Diagram 1



Musical Illustration 1

BASIC ROWS FOR 16 STAGE SEQUENCER

Basic Rows for 16-stage sequencer



MELODIC-RHYTHMIC RELIEFS (or "Prism Melody")

(Diagram 2, Musical Illustration 2, Example 3 on tape *)

Although a single row of 16 ordered pitches is the basis for this idea, the constant shifting of emphasis as it moves along creates an "aural illusion" that conceals its simple origin. A constant pulse is the basis for the rhythm, and larger rhythmic units are created by timbral emphasis and registral displacement. In some ways this musical technique is related to serialism; however, it was actually born from the seemingly inevitable consequences of an Arbitrary Function Generator meeting a Sequencer.

AFG Output 1 (Osc. 1) is set on External Row A (alternate) at +0 range. (Usually I would give this simple alternation of pitches a "spatial rhythm" by routing the pulse output of the 246 to the 265 stored random voltage input, and the 265 output to a spatial locator. Or I might give it a more discrete and regular rhythm by using a 264 Sample and Hold and a small sequencer, as described in attached Diagram 5.)

AFG Output 2 (Osc. 2) is being strobed by the sequencer pulse, and with an external control voltage from the 265 Uncertainty Source such that a new stage of the AFG is jumped to with each pulse. By driving the AFG in "strobe" mode, I free the "Interval time" output

to be used for other than timing control, in this case, for waveshape control. Since all of the AFG voltage sliders except the first one are set at External Row B, AFG 2 will be for the most part looking at a regularly recurring pitch sequence: no matter which stage is strobed to, AFG 2 will see the next pitch of Sequencer Row B. But other variables can be individually programmed at each stage, such as octave transposition, waveshape, or output pulse, resulting in registral, timbral, and rhythmic variations upon the given pitch sequence. The effect is to produce an illusion of several lines going on at once, each one with its own perceived continuity.

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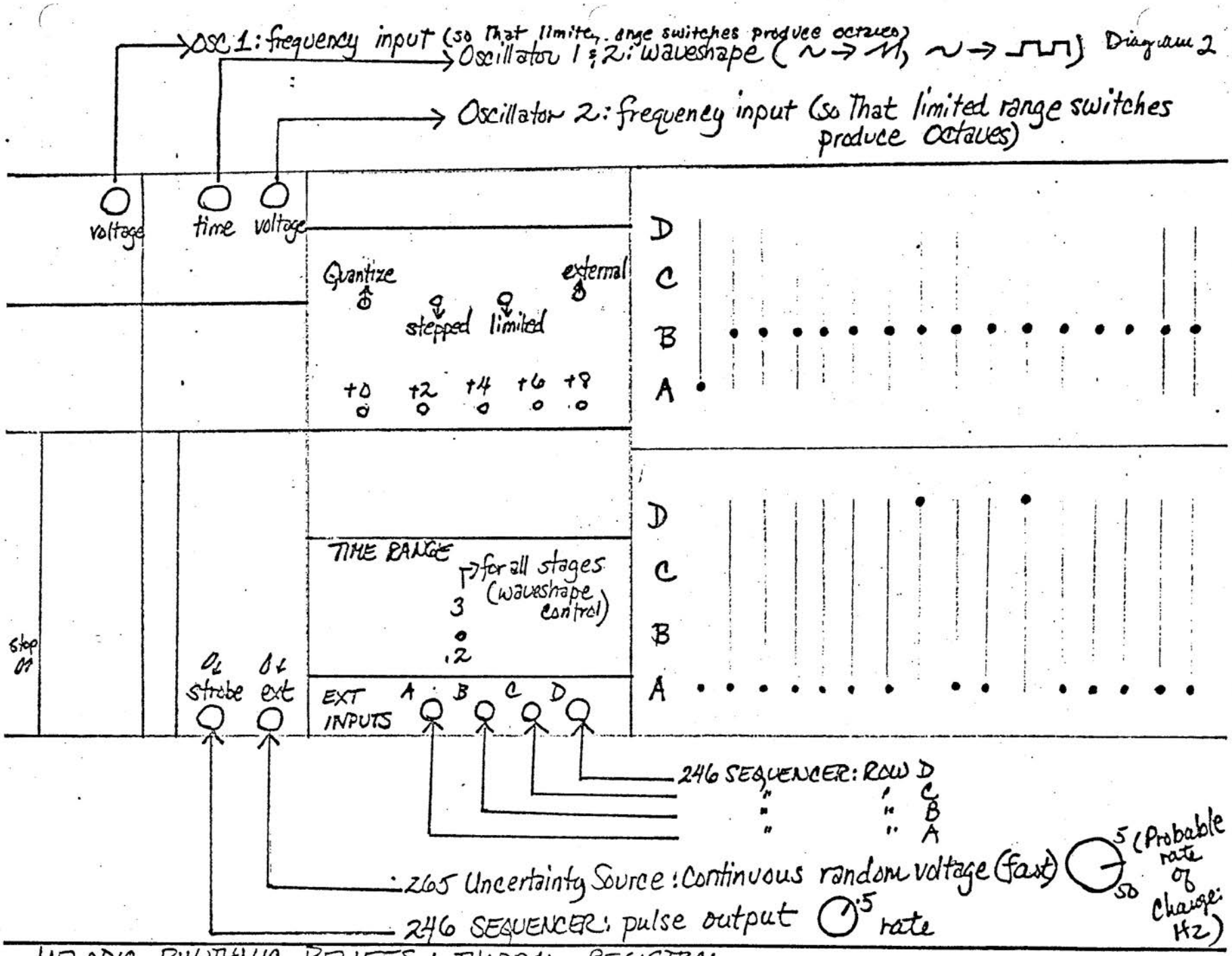
* - (The tape example includes a white noise "click track" and gated/filtered white noise on the 11th pulse of the sequencer.)

MELODIC-RHYTHMIC RELIEFS

"Prism Melody"



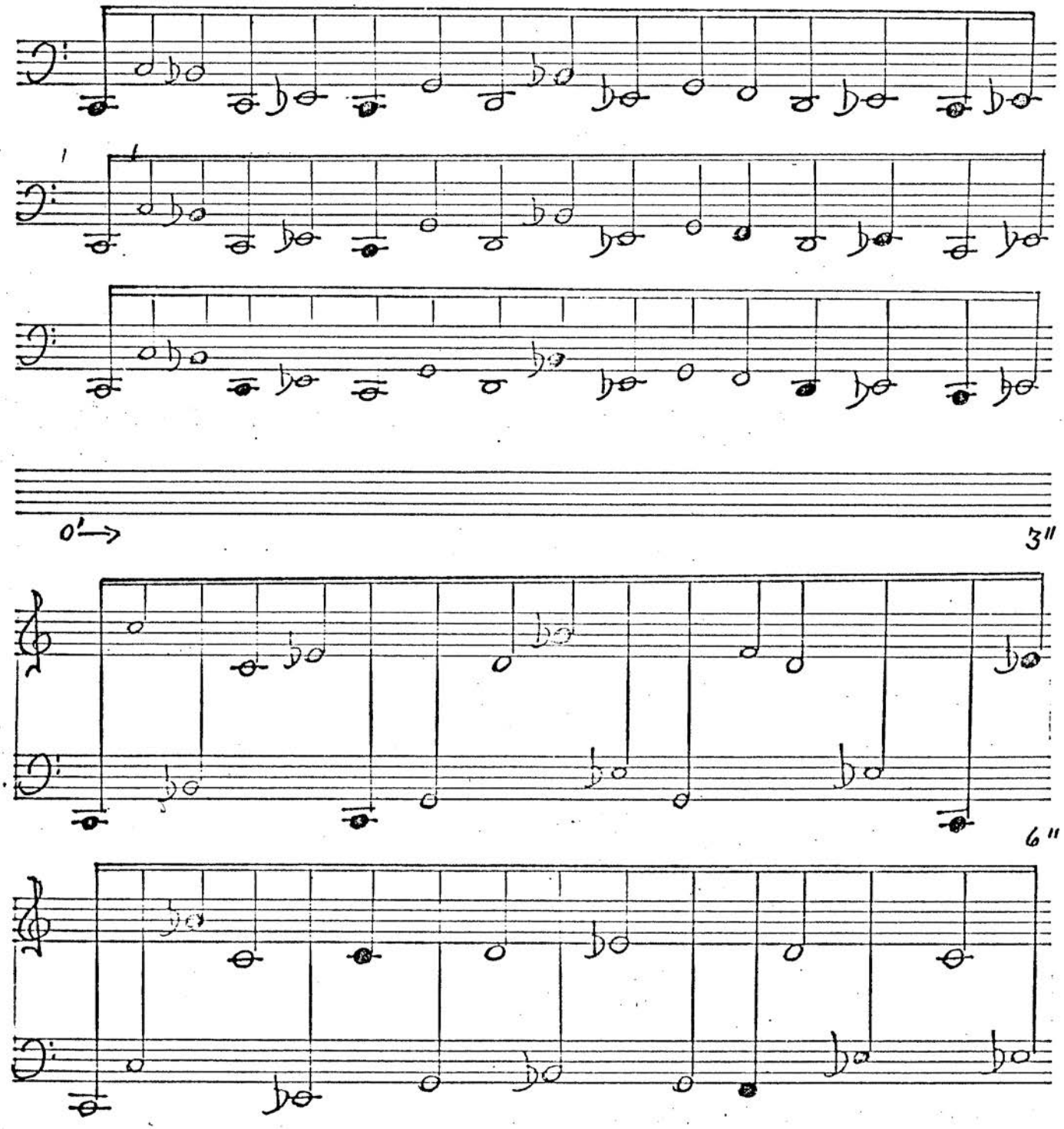
MELODIC-RHYTHMIC RELIEFS: TIMBRAL, REGISTRAL

Musical Illustration 2

MELODIC-RHYTHMIC RELIEFS: timbral, registral

MELODIC-RHYTHMIC RELIEFS: timbral, registral

sawtooth
sine



THE VERTICAL SEQUENCER

(Diagram 3, Musical Illustration 3, Tape Example 2)

This idea is also the product of the AFG and the Sequencer. The four pitches at each stage of the sequencer are arpeggiated by the AFG, which then advances the sequencer to its next stage, and so on. This produces a regular harmonic rhythm and a musical texture characterized by an interweaving of melodic lines.

The External Output Voltage Levels of the AFG are distributed among Rows A, B, C and D at various octave levels.

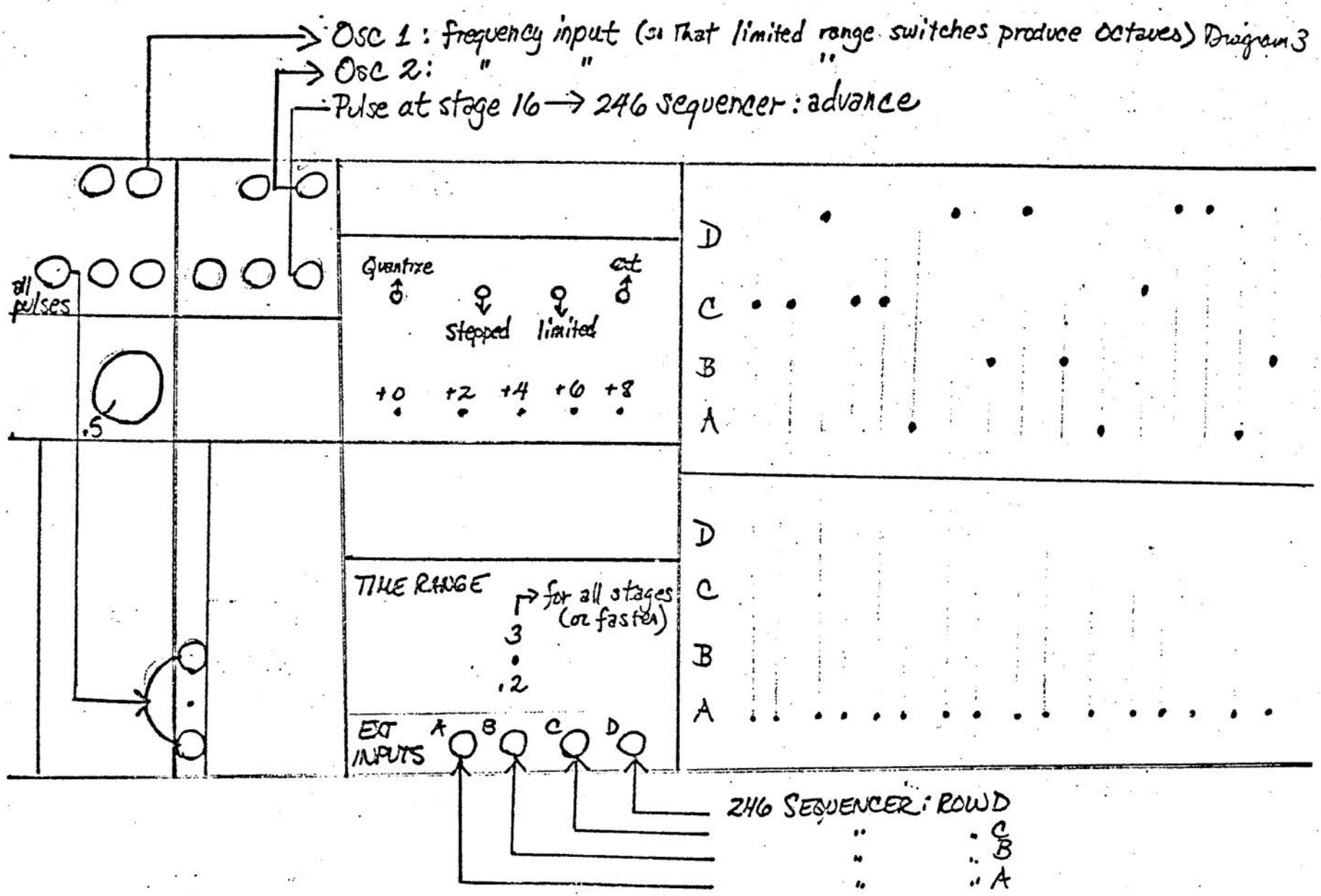
A series 2 pulse is programmed at stage 16 of the AFG to advance the 246 Sequencer. (The pulse "2" output of AFG 1 is patched into the "advance" input of the sequencer.)

AFG 1 is driving AFG 2 from its "all pulse" output. At first the two AFG output units track the 16 stages in unison. Then AFG 2 is manually advanced to separate from AFG 1, producing a distinctly separate voice.

At each pass of the 16 stages, a different set of four pitches from Rows A, B, C and D of the sequencer will be played at various transpositions resulting in a harp-like melodic-harmonic texture.

Feel free to change the limited range switches and the output voltage sliders to different external positions, or to manually advance the AFG 2 output in order to bring out different melodic contours in this texture.

VERTICAL SEQUENCER



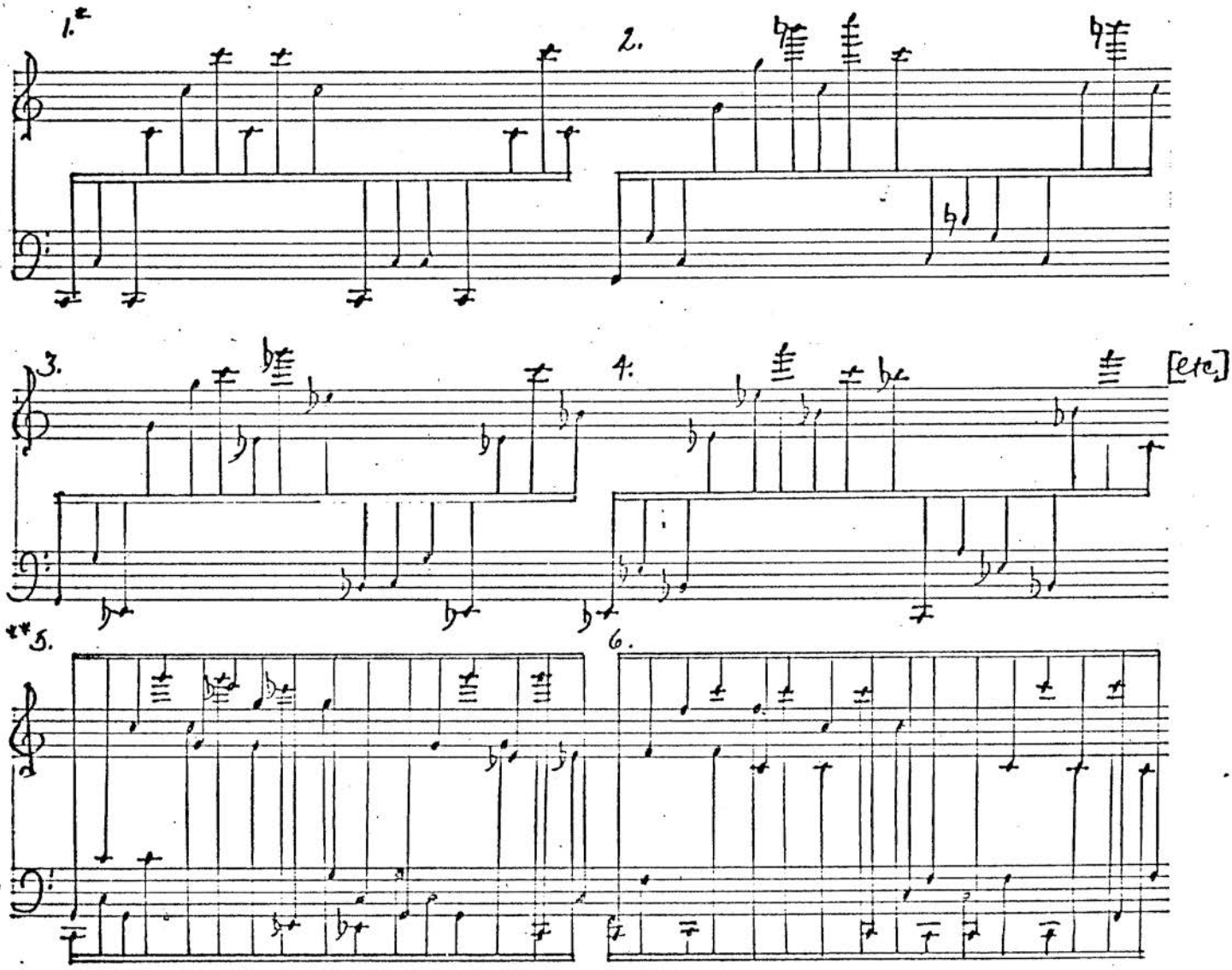
VERTICAL SEQUENCER

Musical Illustration 3

VERTICAL SEQUENCER

VERTICAL SEQUENCER

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	: Stage
+	0	2	0	4	6	8	4	8	6	0	2	2	0	4	8	4	: Range
	C	C	D	C	C	A	D	B	D	B	A	C	D	D	A	B	: Row



* refers to the number of the sequencer stage (1→16)
** pattern obtained by advancing one output of AFG by 2 stages.

THE STRING PATCH

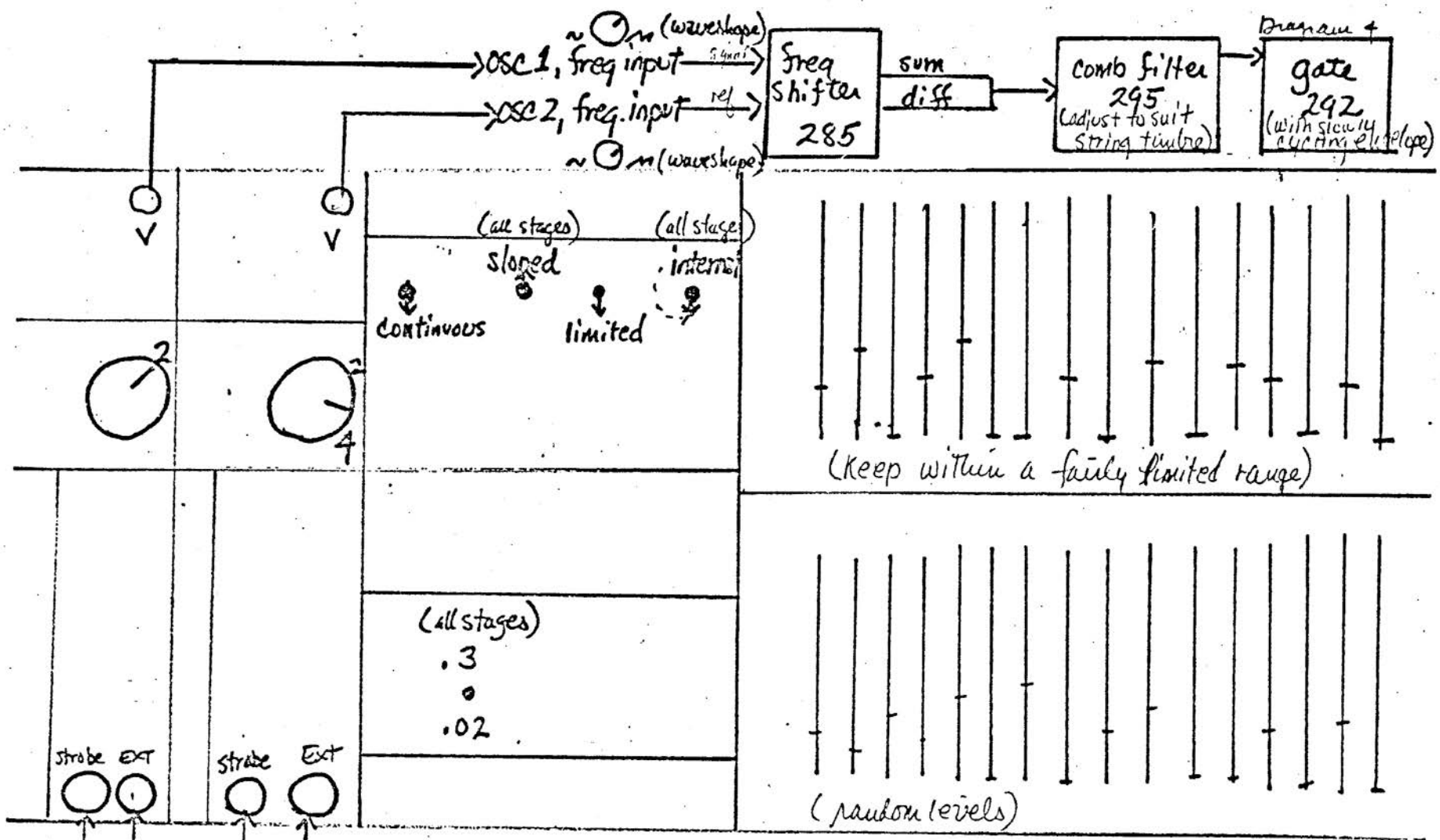
(Diagram 4, Tape Example 1)

This patch produces extremely rich string-like tones and a distinct impression of "bowing." It is also an example of a patch that "plays" itself.

The two AFG outputs work together, at a unison or an octave, being strobed simultaneously by a rapid pulse from the sequencer, along with a very slowly changing external control voltage. Since the "sloped" function, however, is at slightly different rates in AFG 1 and 2, every time there is a movement, always to an adjacent stage, left or right, the frequencies of the two oscillators separate somewhat, and the frequency shifter for a moment sees two signals not in integral relationship and produces a timbral or "bowing" inflection.

In a performance, I will change the overall range of the "strings," finding that the sound works equally effectively from bass to violin range.

STRING PATCH



STRING PATCH

KEYBOARD ROTATIONS *

(Musical Illustration 4)

The Black and White Keyboard gives an illusion of polyphony -- up to three voices -- by means of a sample and hold circuit, but rather than use this feature to play chords, I prefer to use it as a contrapuntal device, by gating all three oscillators together, to produce shifting melodic patterns.

The basic patterns I show in the illustration are produced by playing an ostinato figure on the keyboard, which is controlling the three simultaneously-gated oscillators, and changing the "number of voices" to 1, 2 or 3.

In our basic Keyboard-AFG-Sequencer Patch, if the sequencer is stopped on stage one, where all the rows are conveniently set at "0" volts, and the AFG is in "external" mode, then the keyboard alone can control the frequency of the oscillators. By taking advantage, however, of the potential control of Osc. 1 and 2 by the AFG-Sequencer combination (waveshape, transposition), further developments of this idea are easily achieved in a performance situation, as we will see in the following performance example.

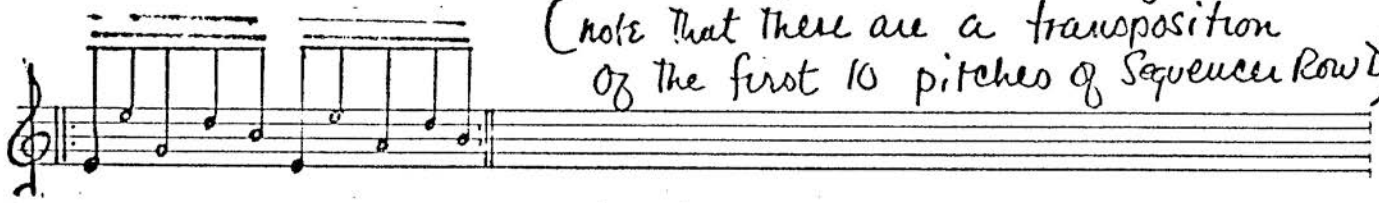
* - The Keyboard Rotations idea could also be accomplished with a monophonic keyboard and a sample and hold or with a sequencer and a sample and hold.

Musical Illustration 4

KEYBOARD ROTATIONS

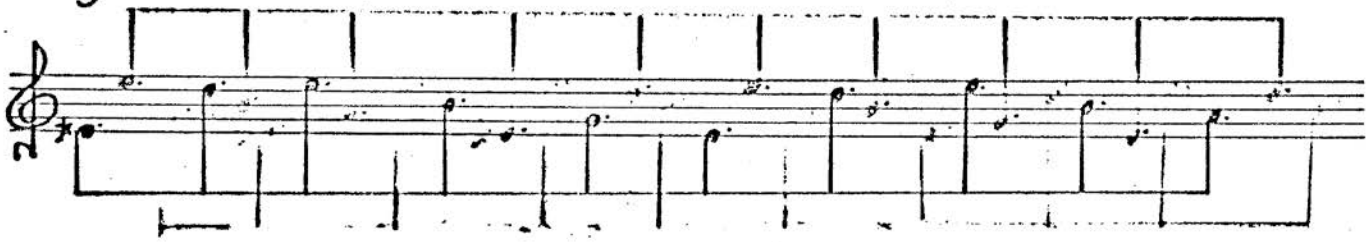
Keyboard Rotations

Keyboard set on unison: 8th note melody, basic ostinato figure.
(Note that there are a transposition
of the first 10 pitches of Sequence Row D)



Keyboard set on 2 voices: 2 3-bar melodic lines, rhythmically different.

Keyboard set on 3 voices: 1 3-bar melodic line, imitated at 5-beat interval.



TO GO FROM "MELODIC-RHYTHMIC RELIEFS" TO "KEYBOARD ROTATIONS" AND BACK AGAIN

As a performance example, let's assume we are going from the "Melodic-Rhythmic Reliefs" patch to the "Keyboard Rotations."

1. Stop the sequencer at stage one with a command from the sub-section of the keyboard. Two of the oscillators (Osc. 1 and 2) are potentially controlled from the AFG. Since the sequencer is stopped and it was driving the AFG, the AFG is now stopped, and I can now position the output stages of the AFG manually. I can do this even while I've begun to play the keyboard ostinato.

2. Leave AFG output 1 at stage 1, External Row A (alternate), set +2 range (this will change the range of what you're playing, but it can be done tastefully), and note that the "internal time" slider, still controlling waveshape, is all the way down.

3. Display AFG output 2, reset it, and then advance it to stage 2. Raise the output voltage level slider to External C position, in anticipation of future needs (step 8) which of course results in no change of pitch since all rows of the sequencer are the same at sequencer stage 1. Hit the +2 interval, and check that the "interval time" slider, controlling waveshape, is down.

N.B. All three oscillators are tuned to be at a unison when the AFG is at a +2 range and seeing "0" volts externally.

4. Continue to play the keyboard ostinato in unison, with all three oscillators sinusoidal in waveshape ... then you might develop the idea in the following way:

5. Switch to "two voices" on the keyboard, and bring the new melodic line (see illustration 4) into relief by raising "internal time" slider of AFG 1 to enrich the waveshape.

6. Display AFG output 2 and switch the range of the output down one octave (hi +0) and raise "internal time" slider at stage two as well.

7. Switch to "three voices" on the keyboard: the imitations (see illustration: the registral change is not shown) will be clear since there are registral and timbral distinctions amongst the voices.

8. Advance the sequencer one stage manually while continuing to play the same notes on the keyboard and a completely new set of imitations will result, one voice up a fifth.

9. Go to other combinations of sequencer stage and "number of voices" which you choose.

10. Return to a unison position, as in the beginning and return AFG output voltage level stage 2 to External position B.

11. Start the sequencer (perhaps with a command from the subsection of the keyboard). You are now back at the Melodic-Rhythmic Reliefs patch and, with the keyboard at "unison" position, you can transpose the Reliefs in Oscs. 1 and 2 and the sustained pitch of Osc. 3, which will sound somewhat like a tonic.

12. Oscillator 3 can be faded out, and you can turn your attentions to developing the Melodic-Rhythmic Reliefs idea.

I have said nothing about the gating and filtering possibilities available in this patch, which is not meant to imply that they are not an important aspect of the musical treatment of any idea. The matrix mixer is a handy routing network that I "play" constantly to get timbral multiples of individual voices and an ever-changing variety of amplitude shapes. These methods of differentiating a sound source from itself are in large part responsible for the illusion that "so much is going on" when in fact the actual sound sources are few.

TO GO FROM "MELODIC-RHYTHMIC RELIEFS" TO "VERTICAL SEQUENCER"

1. Start distributing the AFG output voltage sliders from External B position to various external positions.

2. Clear all pulses, first making sure that the gate is open so that the sound does not disappear, and then program in one pulse in series 2 pulse output at stage 16 by using the "stage no" control to get to stage 16.

3. Take the pulse 2 output of AFG 1 and patch it into the "advance" input of the sequencer.

4. Remove the strobe input pulse from AFG 2, "display" and "reset" AFG 2, patch the "all pulse" output of AFG 1 into AFG 2 bridged "start" and "stop" pulse inputs, stop the sequencer and start AFG 1 (which will drive AFG 2).

5. Now the harp-like melodic-harmonic patterns of "vertical sequencer" are playing.

6. Change the limited range switches either while in "display" mode or via the "stage no" control to change the contours of the texture.

7. Hit "display" and "advance" on AFG 2 to separate it by at least one stage from AFG 1, introducing a distinctly separate voice (see illustration).

8. You could limit the number of stages of the sequencer to change the harmonic movement, or change the harmonic rate by adding additional pulses in the second output pulse series, which is advancing the sequencer.

TO GO FROM "VERTICAL SEQUENCER" TO THE "STRING PATCH"

1. Set the internal rate of the sequencer at .005. (At present, in the "vertical sequencer." the sequencer is being advanced externally.)

2. Patch from the sequencer all pulse output to the strobe inputs of AFG 1 and 2. This will have no noticeable effect since the sequencer is not on, only a respcnse when a series 2 pulse advances sequencer.

3. Set the probable rate of change on the 265 Uncertainty Source between .05 and .5Hz. and patch the continuous random voltage into the "ext" inputs of AFG 1 and 2, if not already there. *

4. Transpose the sound to an upper range by sweeping through all 16 stages with the "stage no" control while holding up the +6 or +8 limited range switch. And similarly, add a "sloped" function all the way across. These movements result in a birdlike sound which obliterates precise melodic shape to facilitate moving from the external to the internal frequency control. It is a transitional device which can be musically interesting if "played": for instance, by adding series 2 pulses.

* - I find that I have to limit the voltage range of this output somewhat, by detouring it through an Adder.

5. Program "internal" mode across the AFG by holding down the "internal" switch while sweeping across with the "stage no" control.

6. Remove all series 2 pulses.

7. Adjust the output voltage levels to a limited range around "0" level to provide a reference from which you can develop the melodic shape.

8. Check the waveshape settings on the oscillators. (The "time" output of the AFG's should not be controlling waveshape in this patch as it is in "Melodic-Rhythmic Reliefs".)

9. Since the sound will be passing through the comb filter, which is tied to gate 3 and envelope 3, loop the pulse output of envelope 3 to its input, setting a slow attack and decay, and open gate 3 enough so that the sound does not completely disappear after the decay.

10. Start the sequencer and stop AFG 1. AFG 1 and 2 will work in unison since their "strobe" and "ext" inputs are bridged.

11. Adjust the range down to a suitable area. These "string" timbres work well from the bass to the violin ranges, and set the output voltage levels where you want them while the patch is playing, developing the melodic contours of this slowly changing line. Other transitional approaches would be possible, but this one works very smoothly.

RHYTHMIC IMPROVISATION

I find that because of the degree of rhythmic responsiveness afforded by the AFG, both alone and in combination with the sequencer, as in our basic patch, a rhythmic improvisation or "cadenza" will be the climax of a performance. Basically, one must be completely familiar with the rhythmic options of a patch before being able to extemporize. With practice, one can develop the mental and physical reflexes to "stay on top" in a performing situation and to play the sound and the space with total control and expressiveness.

The following is a list of some of the rhythmic possibilities of our AFG-Sequencer patch, which are so numerous that I mention only a few:

1. Program pulses on four stages of AFG series 1 pulse output: stages 1, 6, 9 and 12, for instance. Strobe AFG 1 with a regular pulse from the sequencer and with a randomly changing external control voltage fast enough to cause movement on each pulse. Drive AFG 2 with a regular pulse from the sequencer by bridging the "start" "stop" pulse inputs with the sequencer pulse output. The result will be a regularly repeating rhythmic pattern in one voice with random metrical accents in the other:

AFG 1 _ etc.

AFG 2 _ etc.

(I separate the pulses into groups of four only for visual readability.)

2. Strobe both AFG 1 and 2 simultaneously with the sequencer pulse output, both with the same randomly changing external voltage fast enough to cause movement on each pulse. (The two outputs will exactly track each other.) Put the AFG into "enable" mode by holding up the "enable" switch while sweeping across with the "stage no" switch. Take pulses from stages 9 and 15, for instance, of the sequencer and patch into the AFG "start" jacks. If the AFG has an internal rate faster than the sequencer, for instance .02 vs. .5, then the result will be a rhythmic ornament:

   Different ornamental rates can be set for each of the AFG's: they will always track each other except when receiving the "start" pulse.

3. Rhythmic functions like the pulse output series can be freely programmed in and out while the AFG is in "display," or via the "stage no" switch. I find that

if I sweep the "stage no" through the 16 stages of the AFG, I am able to "pick off" any stage on which I might want to program a pulse -- this can even be done with one hand -- or a "sust" or "enable."

I might also add that the "sloped" function of the AFG is very handy in percussive passages for introducing a tabla-like pitched drum quality, whether in "external" or "internal" modes.

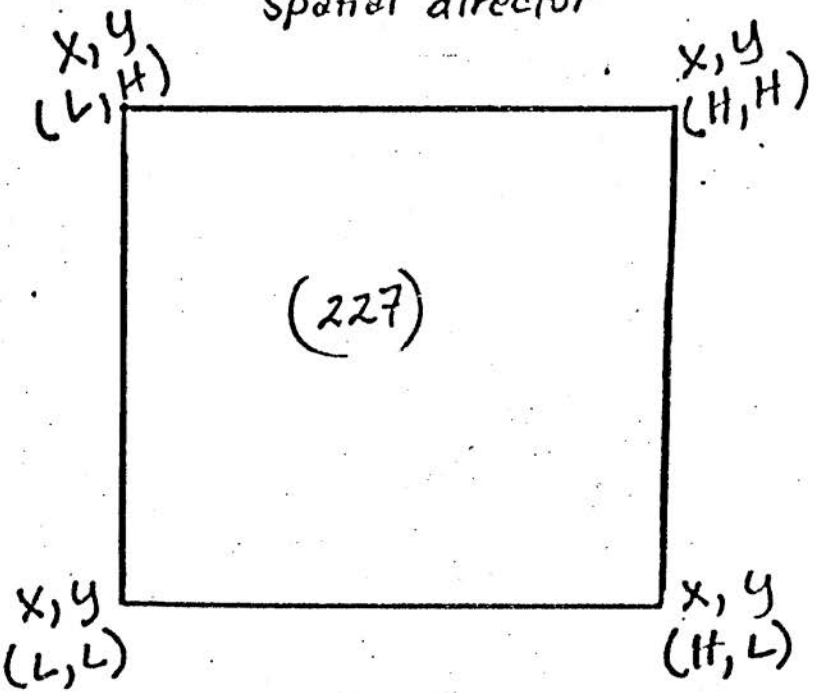
Diagram 5

High-Low Combinations for Discrete Spatial Placement with a 227 (or 204) spatial director

* Note on discrete spatial location patterns using a small sequencer, a Sample & Hold, and a Spatial Locator.

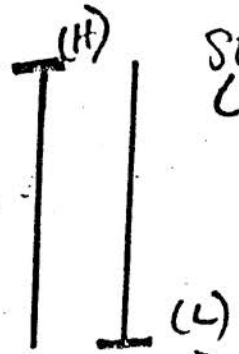
New spatial rhythms can be quickly achieved by changing the number and/or levels of the sequencer stages or by changing the number of stages of the sample and hold. To correlate these rhythms with keyboard passages, for instance, the sequencer could be driven externally with a keyboard pulse.

High-Low Combinations for Discrete spatial placement with a 227[or 204] spatial director



*Note on discrete spatial location patterns using a small sequencer, a Sample & Hold, and a Spatial Locator.

L = Low
H = High

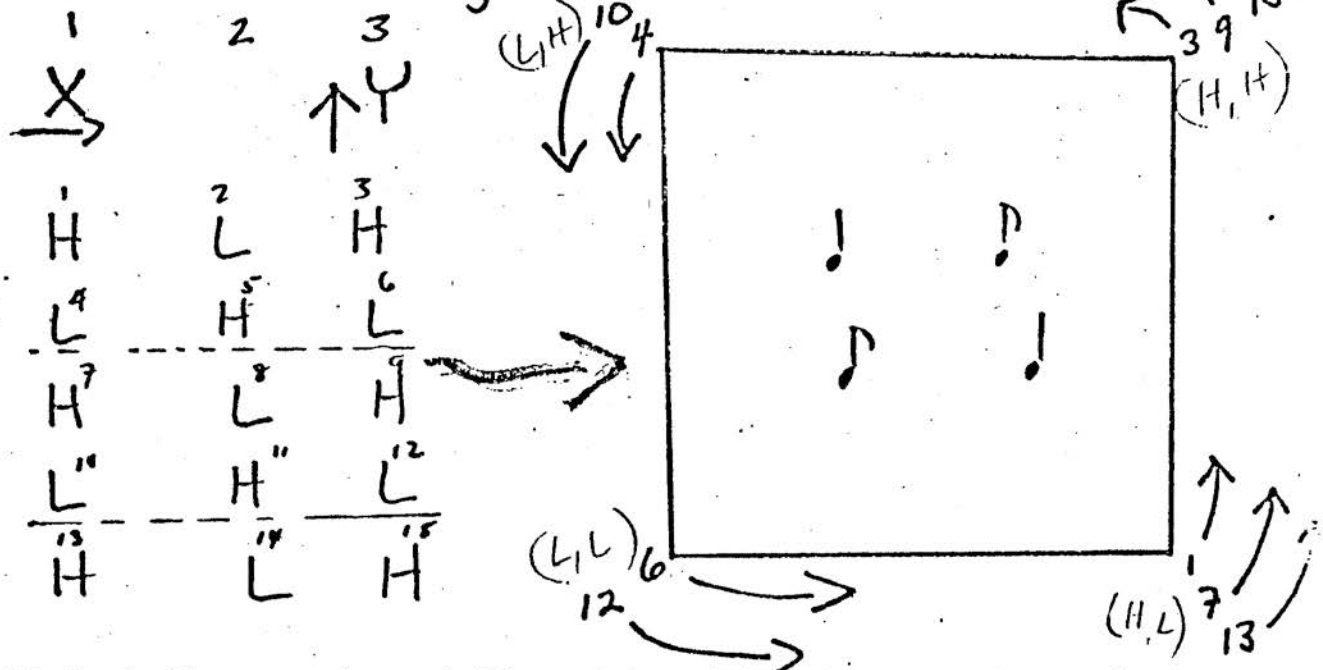


SEQUENCER (2 stages)

PULSE OUT → S & H Pulse INPUT
VOLTAGE OUT → COMMON INPUT of S & H

264 SAMPLE & HOLD (3 stages)

OUTPUT 1 → 227 "X" voltage input
OUTPUT 3 → 227 "Y" " "



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