PRACTICAL SYNTHESIS FOR ELECTRONIC MUSIC

VOLUME TWO

2ND EDITION

Roland

Contents

List of illustrations and Patch Diagrams

Chapter One:
Block Diagrams

1-1 Introduction

There are many occasions when it is necessary to make notations as to how a given sound was produced to make it possible to easily reproduce that sound sometime in the future. With smaller synthesizers, particularly the type often used in live performances, the simplest approach is usually to obtain a blank panel diagram for the particular synthesizer in question and use it for marking the positions of the controls. Fig. 1-1 shows an example of such a diagram. For modular type systems, however, this method can become quite cumbersome. Since the modules can usually be interchanged freely, a "standard" panel diagram would represent only one possible system arrangement. The simplest approach to this problem is to use hand-drawn block diagrams. Such diagrams can be as simple or as detailed as needed to show how the sound is produced.

Fig. 1-1 Patch Diagrams

ⓐ Roland SH-101 Synthesizer

ⓑ Blank Panel Diagram
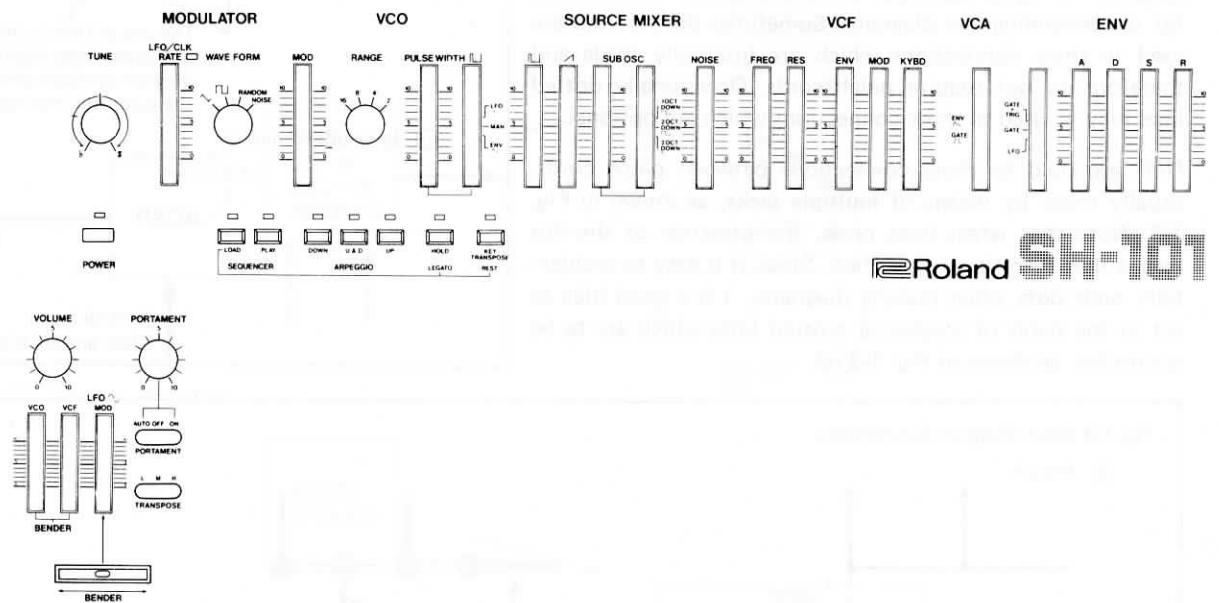
ⓒ Patch Diagram for Synth Voice
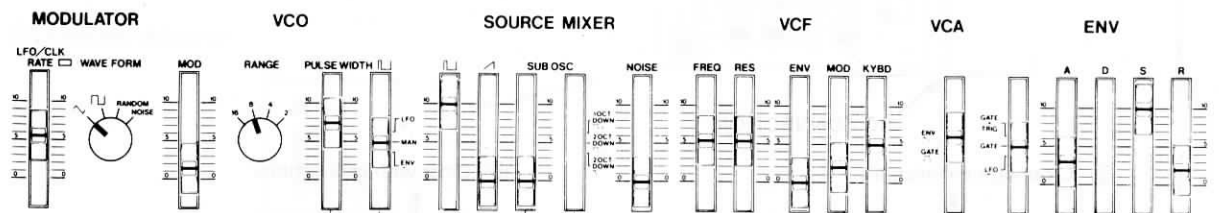
1-2 Signal Flow in Block Diagrams

A **block diagram** can be thought of as a simplified road map which shows how audio signals and control voltages flow from one element to another in the system. Squares, or sometimes rectangles, are used to represent each element in the synthesizer patch. Sometimes, as in this book, triangles are used for those elements which are based on amplifier circuits; for example, mixers and VCA's. Fig. 1-2 shows some examples.

Generally, audio signals flow from left to right with inputs entering the left sides of the blocks and outputs leaving the right sides. Audio devices are usually shown in the upper portion of the diagram and control elements in the lower portion. Control voltages and pulses usually travel from left to right and/or from bottom to top. As with audio signals, control voltages and pulse outputs usually leave the right sides of the blocks, but they usually enter from the bottoms. The major exception to this rule in this book is that the keyboard control outputs are shown leaving from the top of the keyboard. Arrowheads are shown to help clarify the direction of signal flow, but these are usually not essential for understanding the diagrams. Sometimes dotted lines are used to show connections which are internally made and therefore do not require patch cords. Occasionally dotted lines may be used to show connections which are optional.

Dots are used to show connections between patch cords, usually made by means of **multiple jacks**, as shown in Fig. 1-3. Note that when lines cross, the presence of the dot means that there is a connection. Since it is easy to accidentally omit dots when making diagrams, it is a good idea to get in the habit of staggering crossed lines which are to be connected, as shown in Fig. 1-3 (c).

Fig. 1-2 Block Inputs and Outputs

ⓐ VCF

Audio input → **VCF** → Audio output

Control input

ⓑ VCA

Audio input → **VCA** → Audio output

Control input

ⓒ Inverter

Input → **INV** ○ → Output

The use of this circle is optional. It is borrowed from electronic circuit diagram symbols and indicates that the output is inverted.

ⓓ Envelope Generator

ADSR → Envelope output

Control input
(Gate and/or trigger)

Fig. 1-3 Block Diagram Connections

ⓐ Branch

Patch cords   MULTIPLE JACKS

ⓑ Cross with no connection

NO CONNECTION

ⓒ Cross with connections

CONNECTION

MULTIPLE JACKS

ⓓ Cross with connections

This is better than ⓒ.

1-3 Control Settings for Block Diagrams

From this point, it is only a simple matter to add **control settings** inside the blocks to show exactly how a sound is obtained. Fig. 1-4 gives examples for showing VCF and envelope generator settings. In (a), the numbers just above the control inputs show the settings for the respective VCF MOD IN controls. In (c), the envelope generator control settings are shown in order from left to right. In other words, ATTACK = 1, DECAY = 1, SUSTAIN = 8, and RELEASE = 0.5. This book uses the systems shown in (a) and (d).

Fig. 1-4 Notation for Control Settings

(a) VCF

VCF
CO = 0

8   5

(b) VCF

VCF
CO = 0
KCV = 8
ADSR = 5
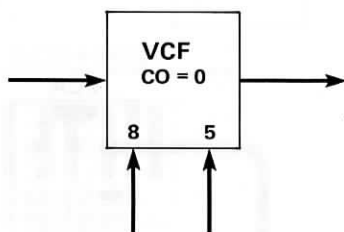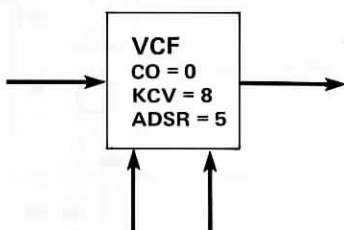
PITCH   ADSR
CV

(c) Envelope generator

ADSR
1/1/8/0.5

(d) Envelope generator

A = 1
D = 1
S = 8
R = 0.5
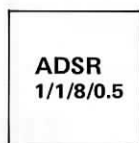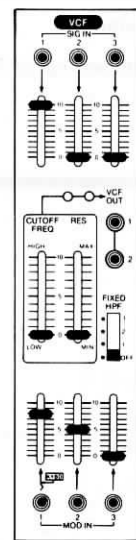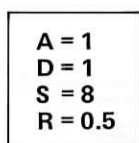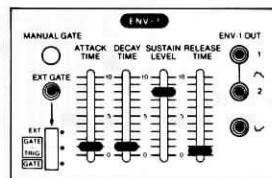
Fig. 1-5 shows a patch diagram for a clarinet sound. In Fig. 1-6 are shown three ways this sound can be shown with block diagrams. The version in (b) is the style used in this book. The version in (c) is perhaps the preferred style for use in the studio because it is quick and easy to write down during production work. Elements which are common to most patches are taken for granted and omitted; only those elements needed for this particular sound are shown.

Other abbreviations used with block diagrams will become clear later since both block diagrams and panel layouts are used for all patches in this book.

Fig. 1-5 CLARINET
(Same as Fig. 1-8 in Volume 1)

Compare with the clarinet settings of Fig. 1-1ⓒ.
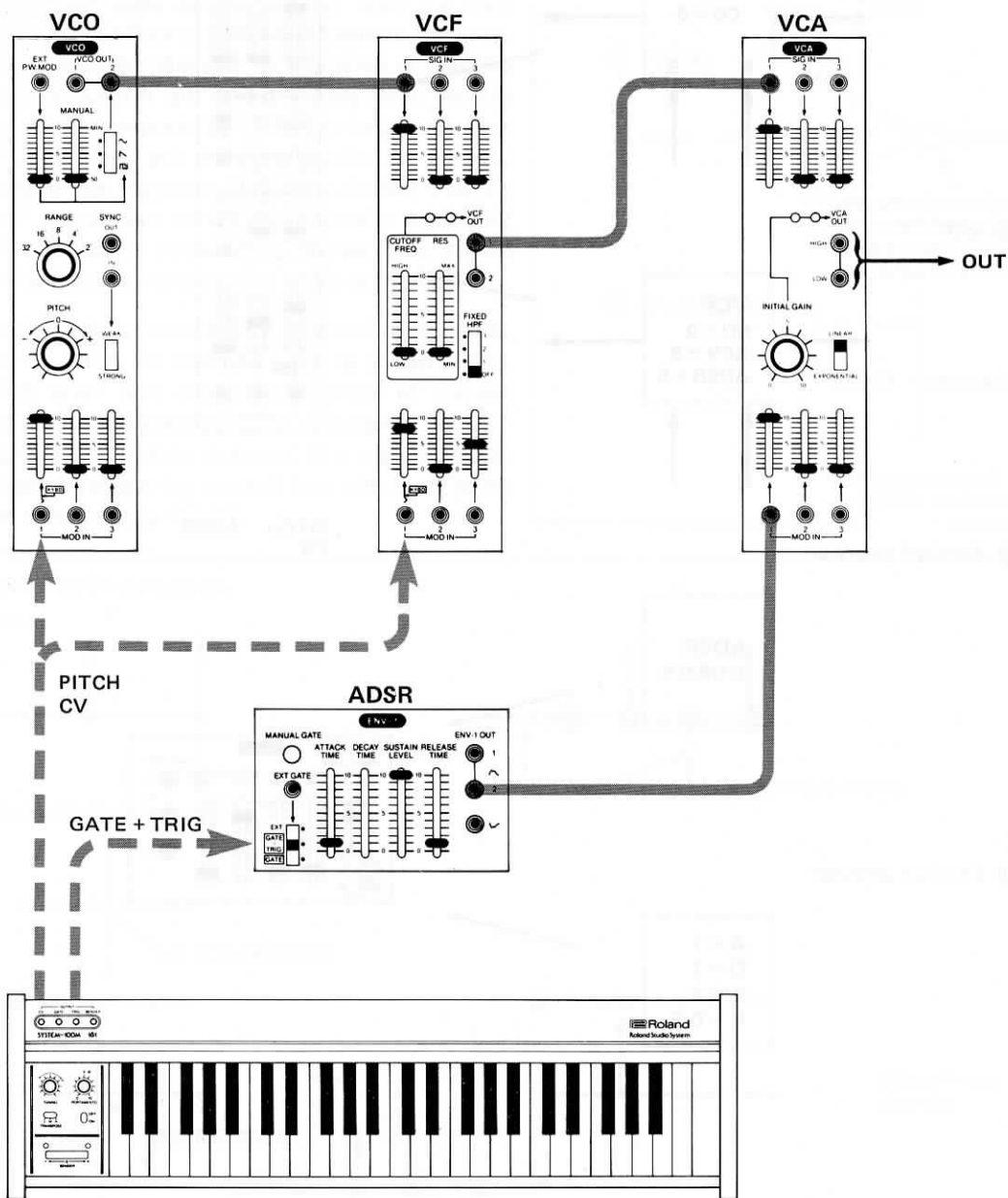
Fig. 1-6 Block Diagrams for **CLARINET**

ⓐ Version 1

ⓑ Version 2

D is omitted since it has
no effect when S = 10.
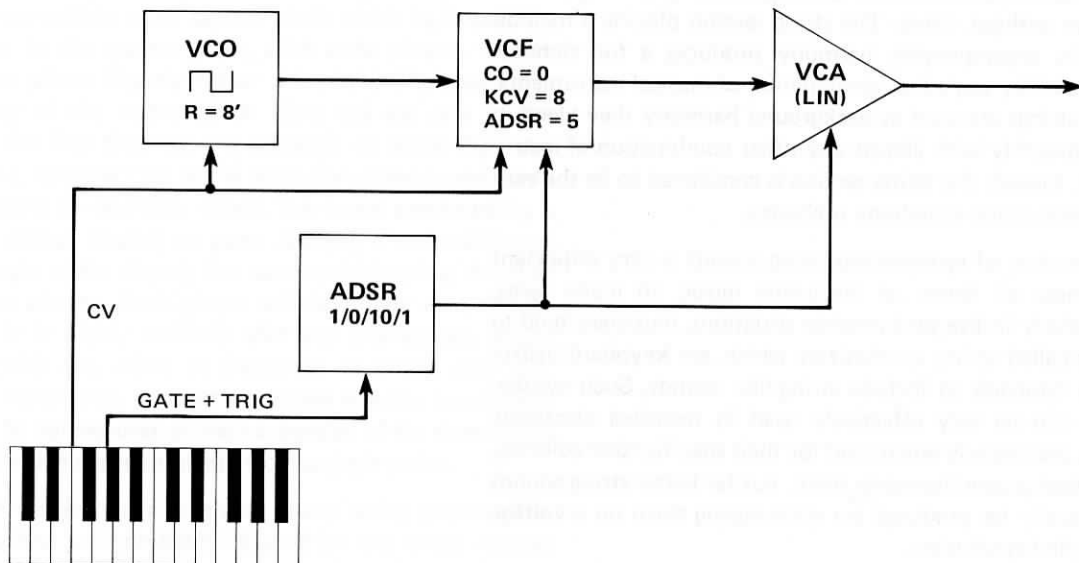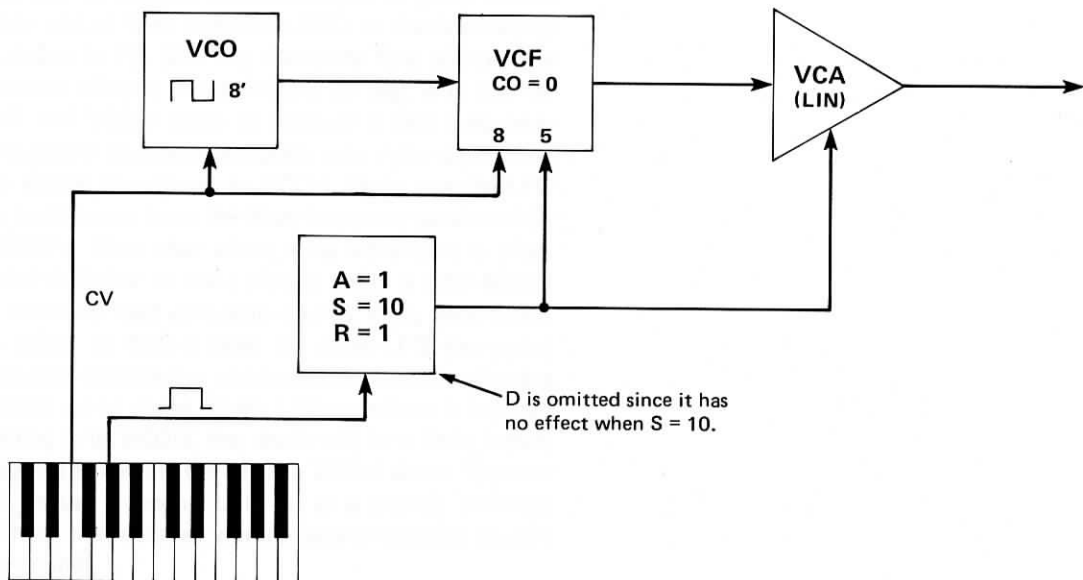
ⓒ Version 3
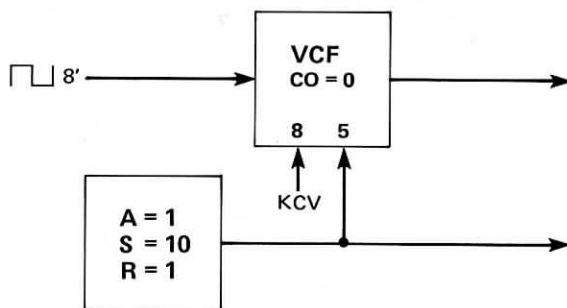
Chapter Two:
String Sounds

2-1   Introduction

The quality of sound produced by a large group of strings is such that the ear can listen to strings playing for long periods of time without tiring. The string section playing a melody with its accompanying harmony produces a full richness unequaled by any other combination of musical instruments. When strings are used as background harmony they blend in very smoothly with almost any other combination of instruments. Indeed, the string section is considered to be the very backbone of the symphony orchestra.

The mastery of synthesizing string sounds is very important to almost all forms of electronic music. In many cases, particularly in live performance situations, musicians tend to use so-called string synthesizers which are keyboard instruments designed to include string-like sounds. Such synthesizers can be very effectively used in recorded electronic music, particularly when used for their specific tone coloring, or as background harmony fill-in, but far better string sounds can usually be produced by synthesizing them on a voltage controlled synthesizer.

2-2 Creating Group String Sounds

In a large group of strings playing in unison it is inconceivable that each and every player would be playing exactly the same pitch. There will be some average pitch which is, hopefully, very close to the correct pitch, with some players slightly above and others slightly below this pitch. The result is a broadening of the sound which gives our ear one of the clues to the fact that we are listening to more than one instrument. Another clue is the intensity of the sound. Even if they could be perfectly tuned, the sound produced by a group of strings playing an open **A** string is quite different from a single violin playing the same open **A** string. Another clue is the vibrato. Each player will have their own vibrato rate and it is highly unlikely that any one vibrato would coincide with any other in frequency or phase. And last, in stereo recordings, a group of strings playing unison will generally be spread over at least a portion of the stereo field rather than seeming to originate from a single point.

There are various ways to create group string sounds. The actual method will probably depend on the effect desired and the equipment available. Try these ideas individually first, then in different combinations.

The easiest way to produce the pitch spread of group sounds is to simply add at least one more VCO to the basic violin patch, as shown in Fig. 2-1. Try the sound first without the LFO generated vibrato. Tune VCO-2 so that it is just far enough off the VCO-1 pitch to produce a beat frequency roughly equivalent to a normal vibrato rate. After trying that sound, try adding the vibrato to VCO-1. Make sure the LFO frequency is different from the beat frequency produced by the two VCO's. Note that when using vibrato, it is often possible and desirable to use a vibrato depth a little greater than that normally used with solo sounds. Also, note that if vibrato is added to VCO-2 using the same LFO, the sound quality actually deteriorates somewhat because the vibratos for the VCO's are in phase. If the LFO waveform is inverted before feeding it to VCO-2, the result will be a little better, but not as good as feeding the LFO to VCO-1 alone. The best solution is to use a second LFO set at a slightly different rate. Also note that delayed vibrato usually does not go well with group sounds.

Fig. 2-1 GROUP STRINGS (Basic violin patch with second VCO added)

ⓐ Block Diagram
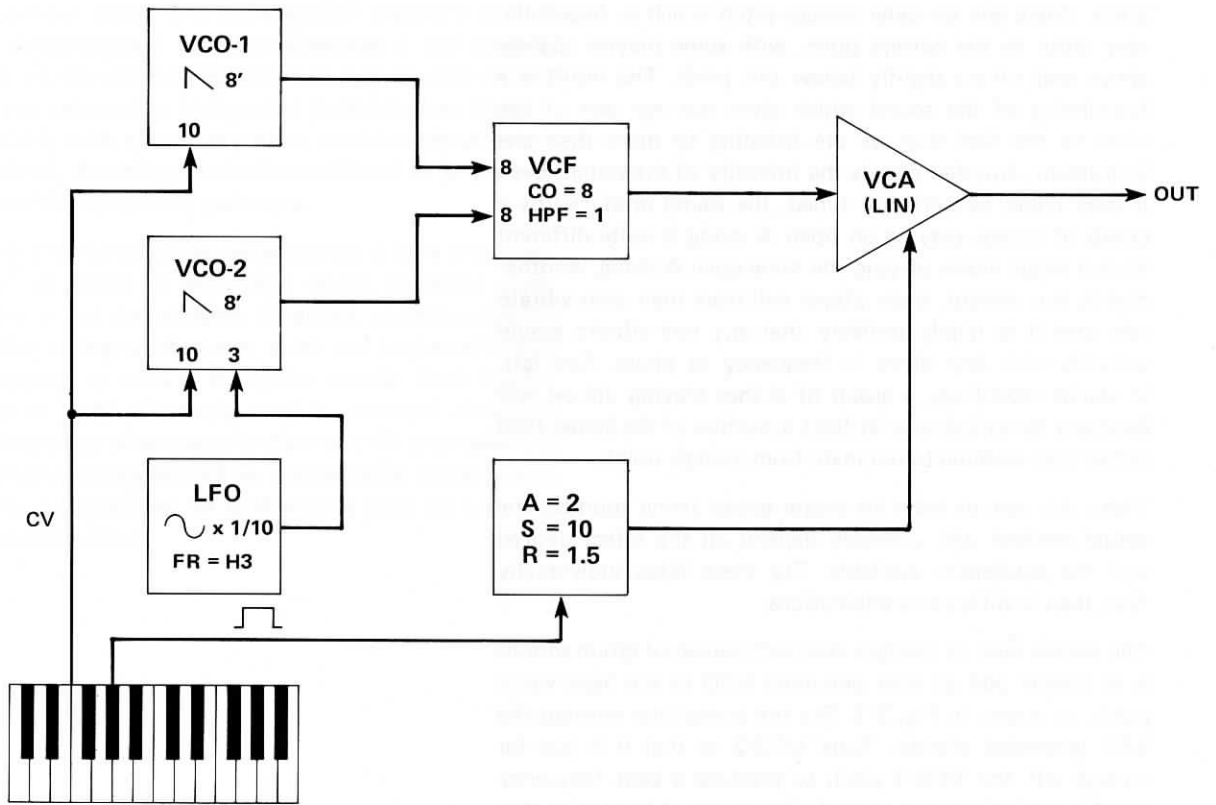
Fig. 2-1 GROUP STRINGS (cont'd)

ⓑ Patch Diagram
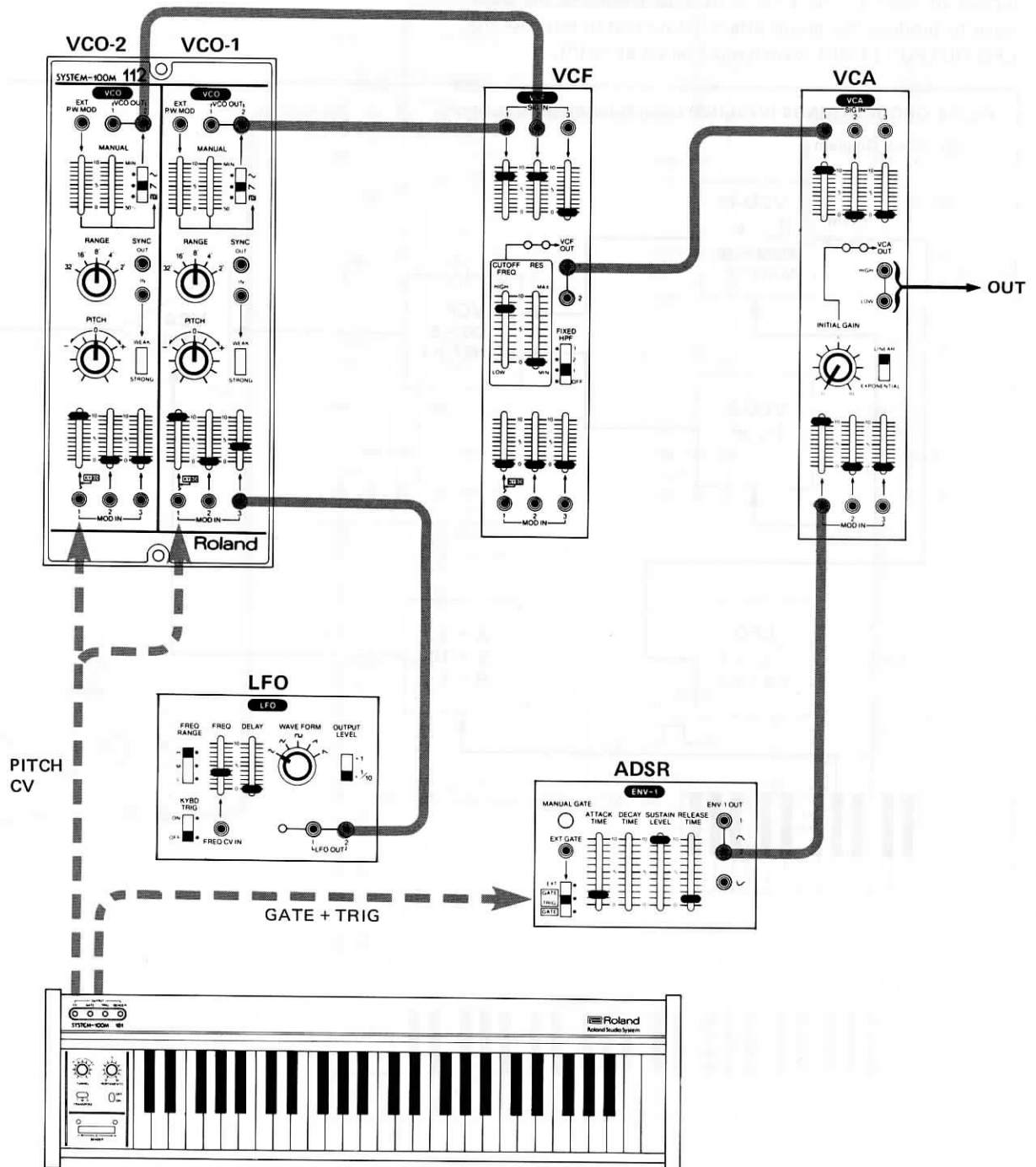
With group string sounds, the actual VCO waveform used seems to have less importance than with solo sounds. Fig. 2-2 shows another violin group sound which uses the pulse wave output of VCO-1. The LFO is used to modulate the pulse wave to produce the group effect. (Note that in this case the LFO OUTPUT LEVEL switch must be set at "x1").

Fig. 2-2 GROUP STRINGS (VIOLINS) Using Pulse Width Modulation

ⓐ Block Diagram
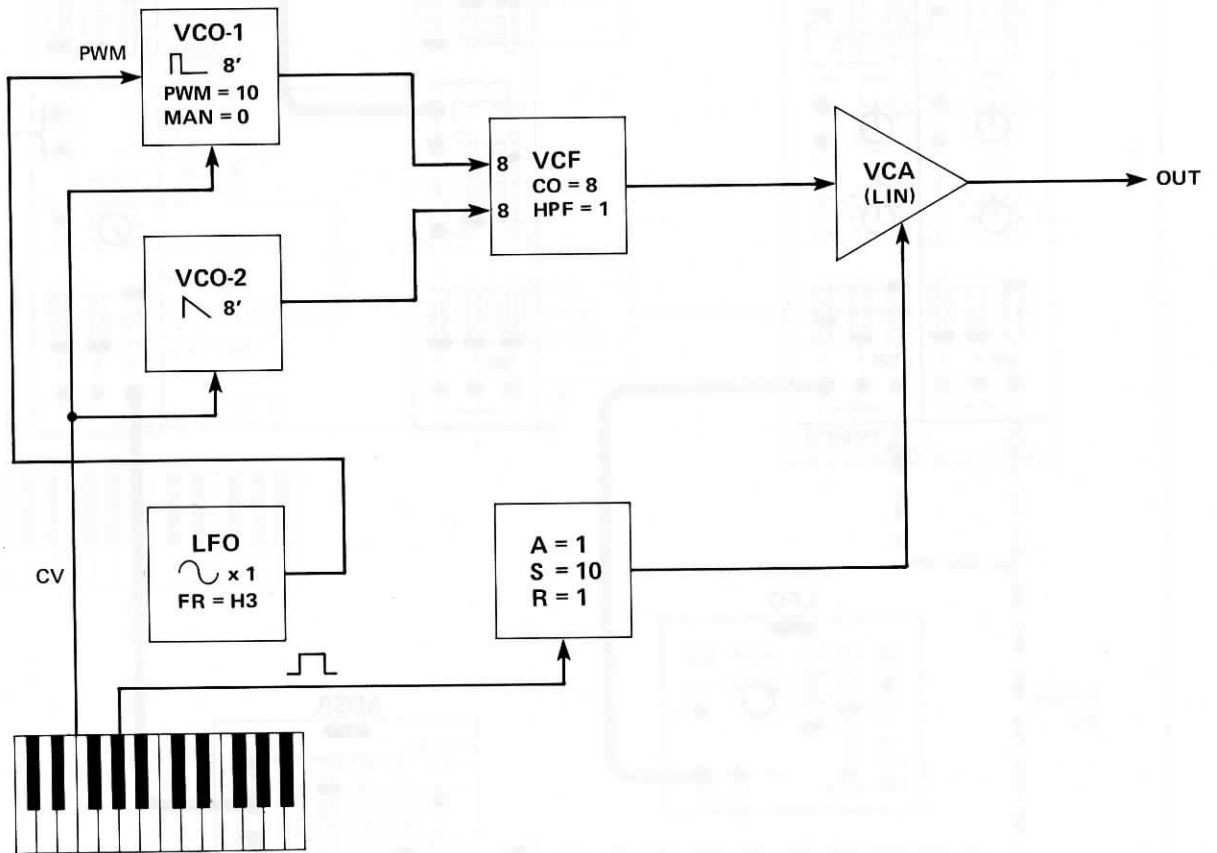
Fig. 2-2 Group Strings (cont'd)

ⓑ Patch Diagram
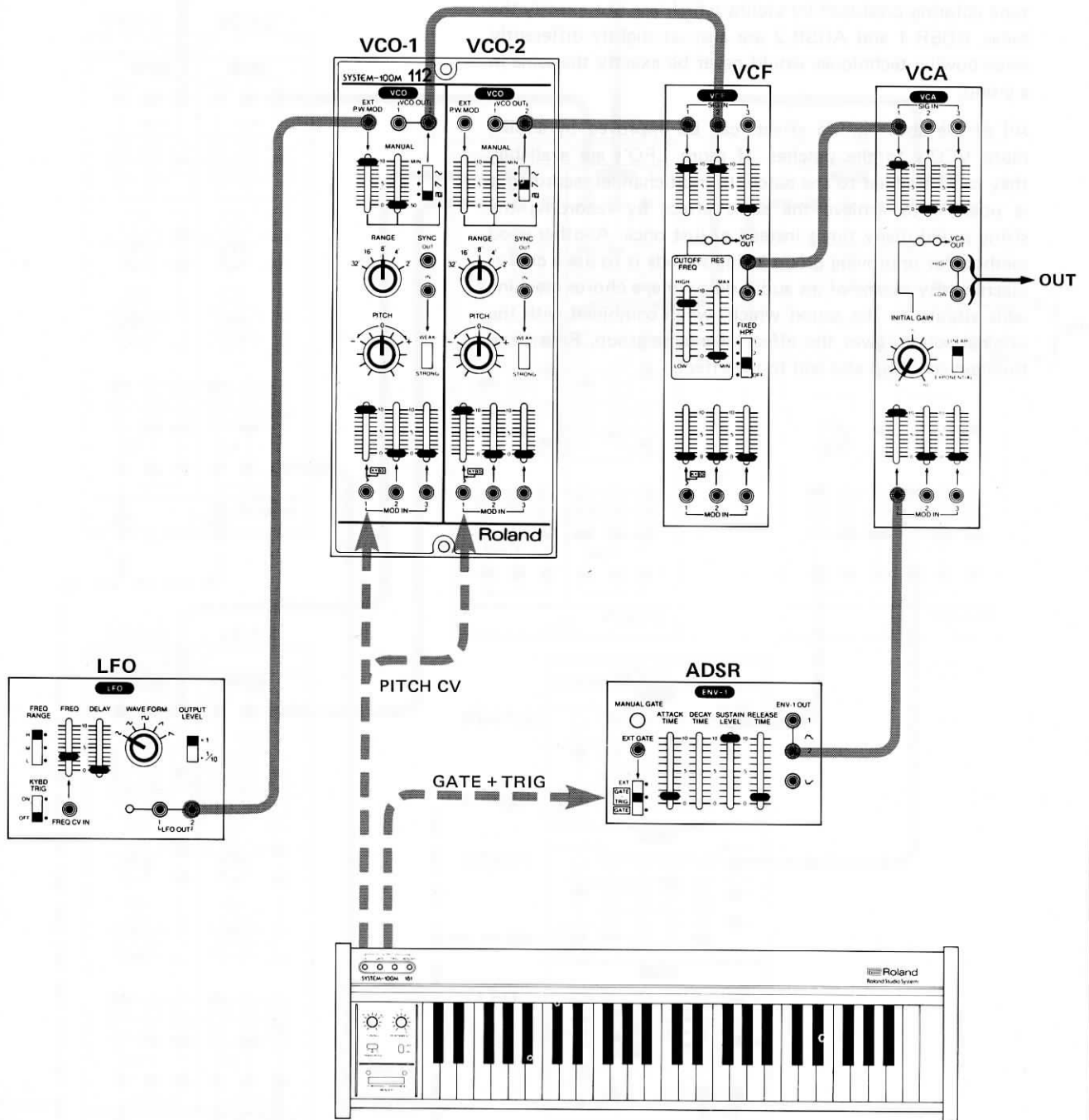
Fig. 2-3 shows a group string effect which is basically nothing more than a doubling of the patch shown in Fig. 2-1. VCF-1 and VCF-2 are set slightly differently to imitate the different tone coloring produced by violins which are not exactly the same. ADSR-1 and ADSR-2 are also set slightly differently since bowing techniques would never be exactly the same in a group.

All of the above group effects can be improved by adding more VCO's to the patches. If more LFO's are available, they can be added to the patch. In multichannel recording it is possible to achieve the same effect by recording the string sound many times instead of just once. Another good method for improving group string sounds is to use a chorus machine. By means of an audio delay line, a chorus machine adds vibrato to the sound which, when combined with the original sound, gives the effect of a large group. Reverberation and echo will also add to the effect.

Fig. 2-3 GROUP STRINGS (VIOLINS) (Doubling of GROUP STRINGS PATCH, Fig. 2-1)
Tune all VCO's to approximate unison.

NOTE: If a second LFO is available,
use it to modulate VCO-1 and
VCO-3.
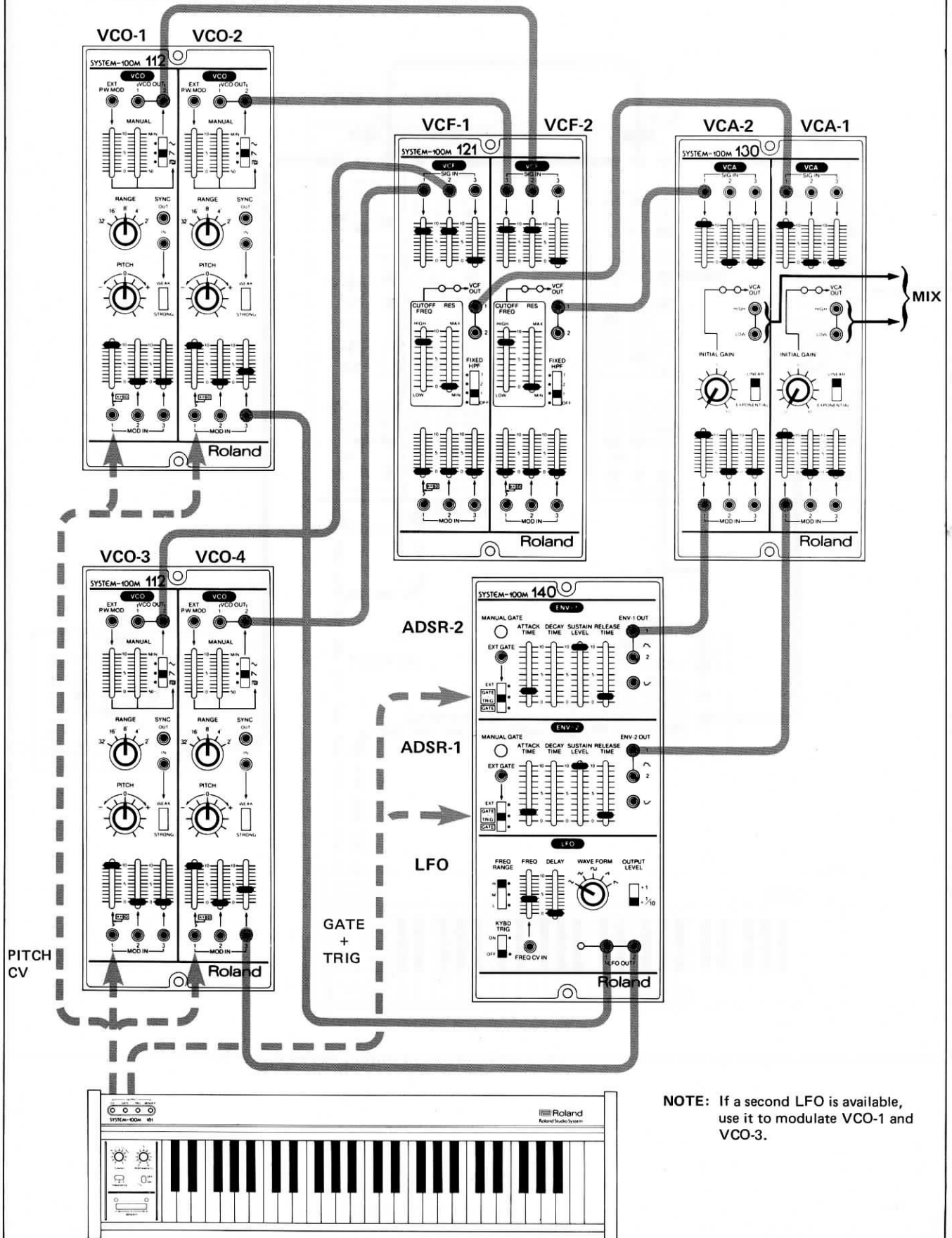
Figs. 2-4 through 2-6 show the basic patches for the other groups of strings.
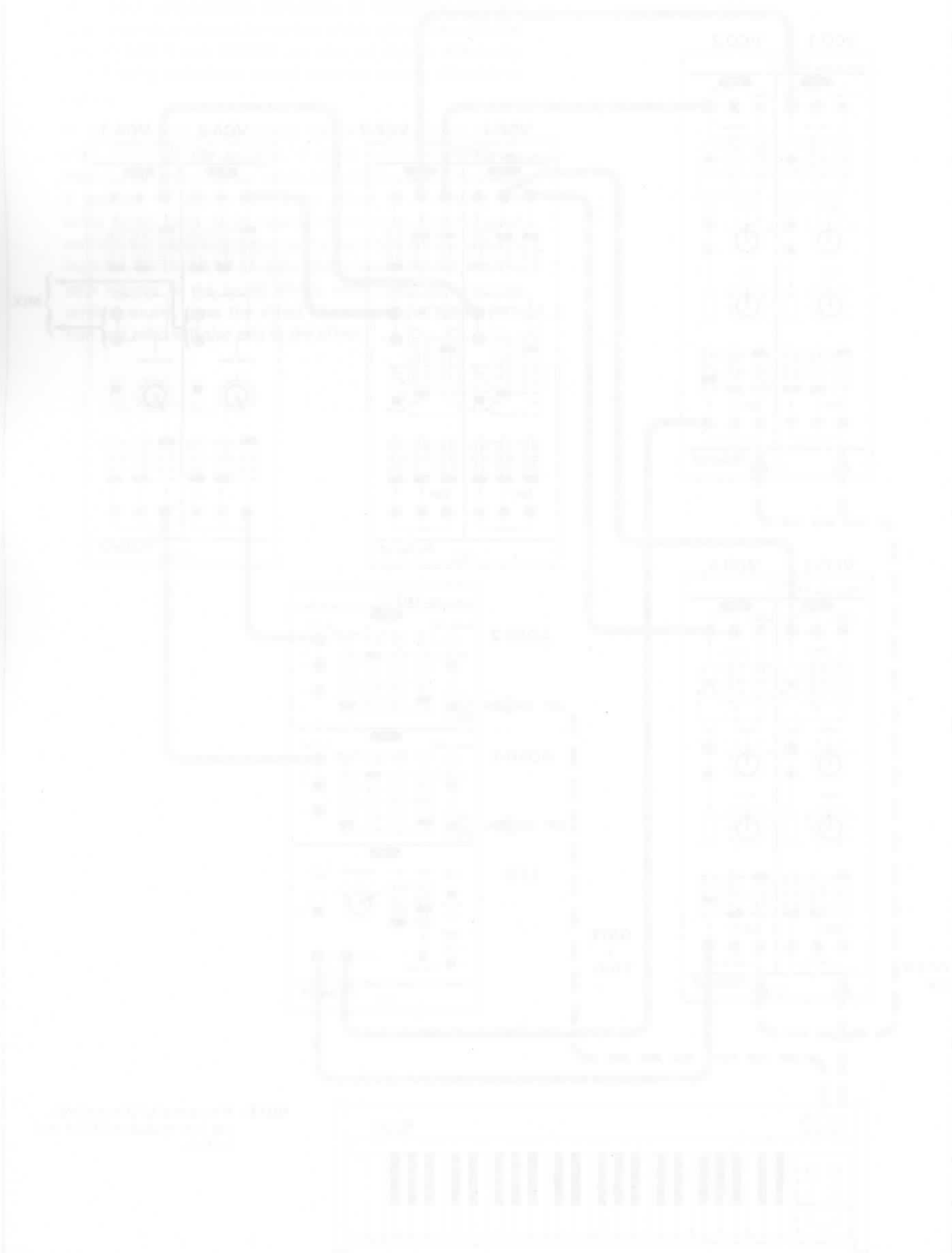
Fig. 2-4 VIOLA SECTION

(Except for control settings, block diagram is same as Fig. 2-2ⓐ).
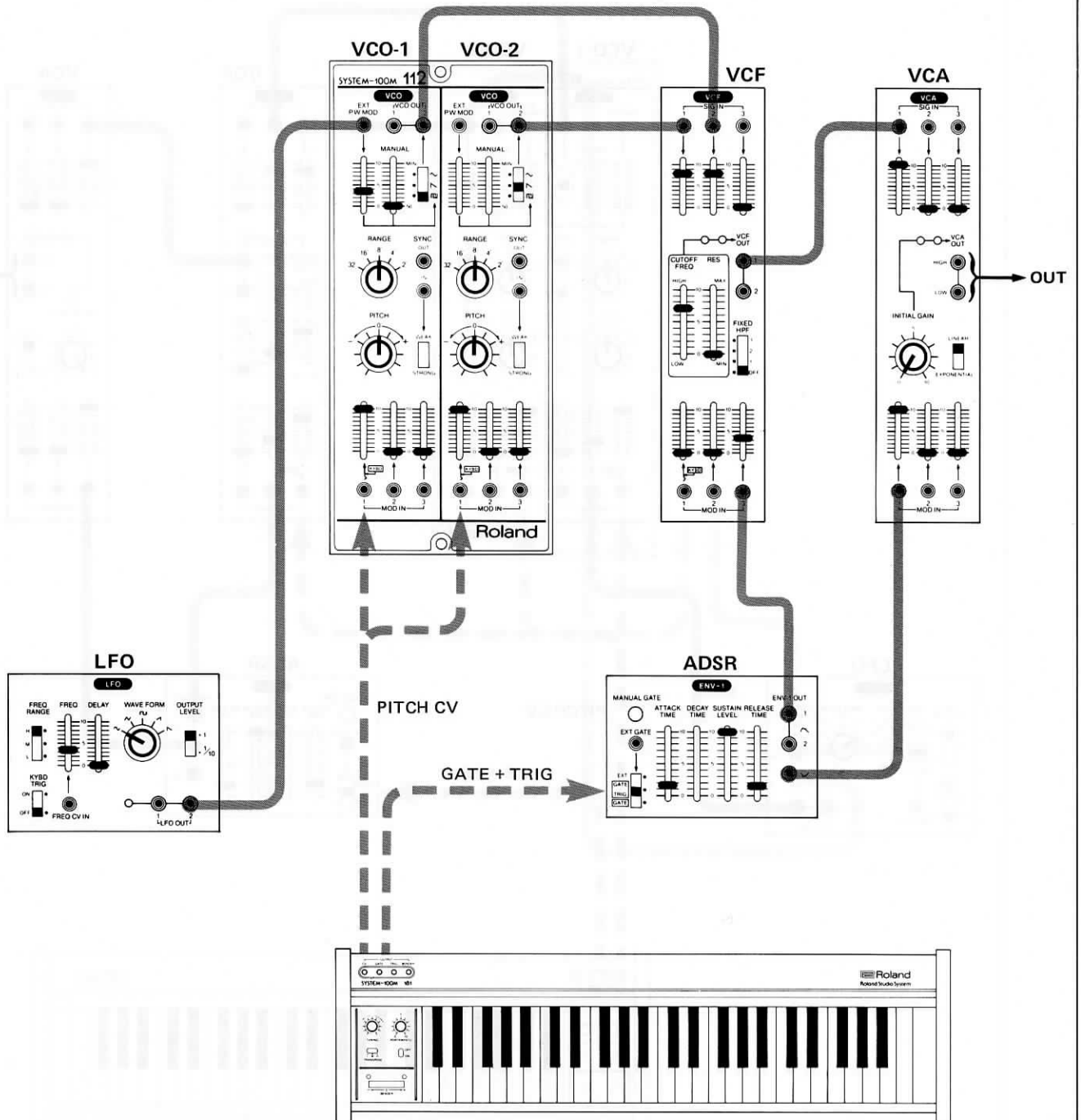
Fig. 2-5 'CELLO SECTION

(Except for control settings, block diagram is same as Fig. 2-1ⓐ).
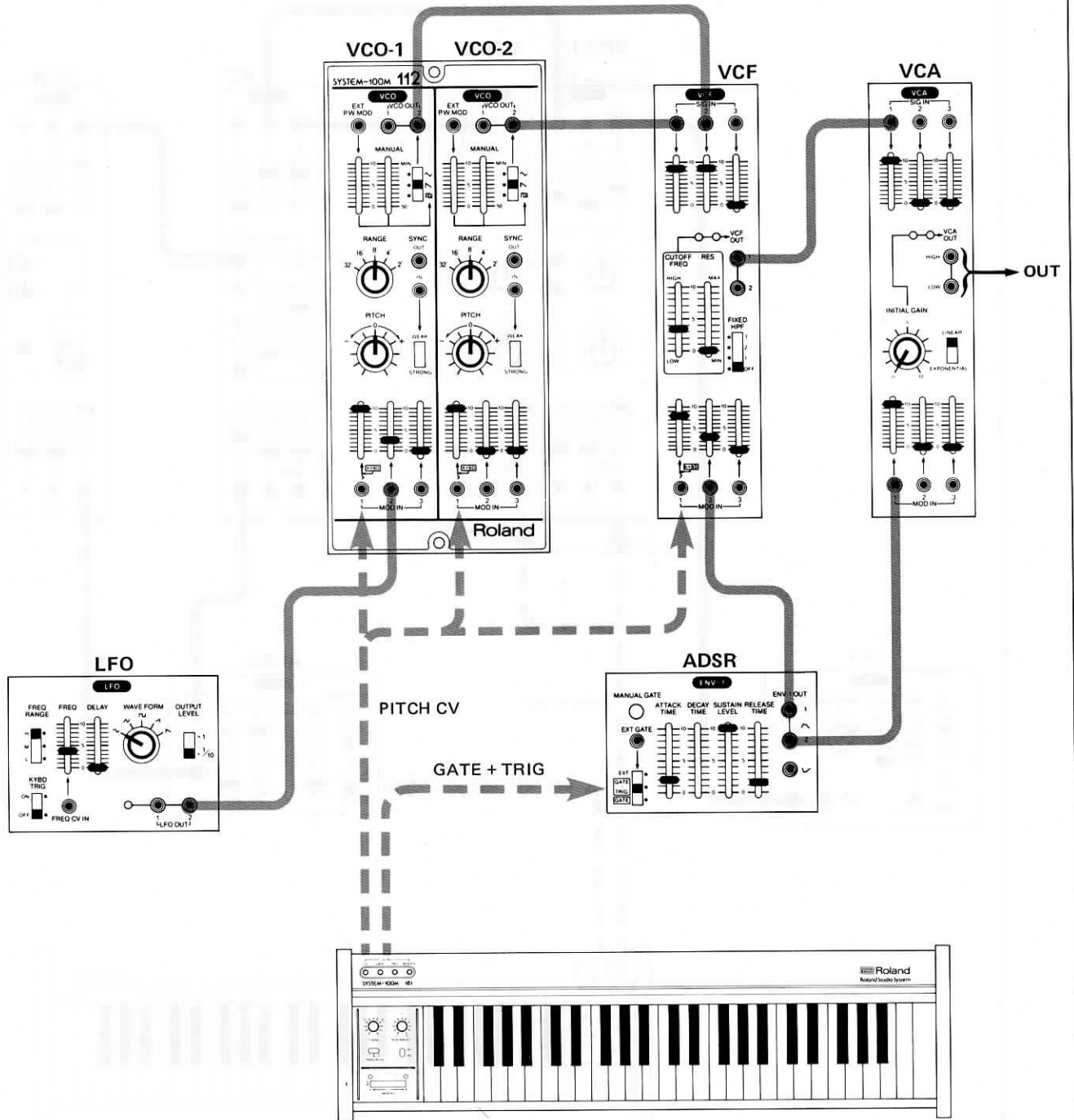
Fig. 2-6 BASS SECTION

(Except for control settings, block diagram is same as Fig. 2-2ⓐ).
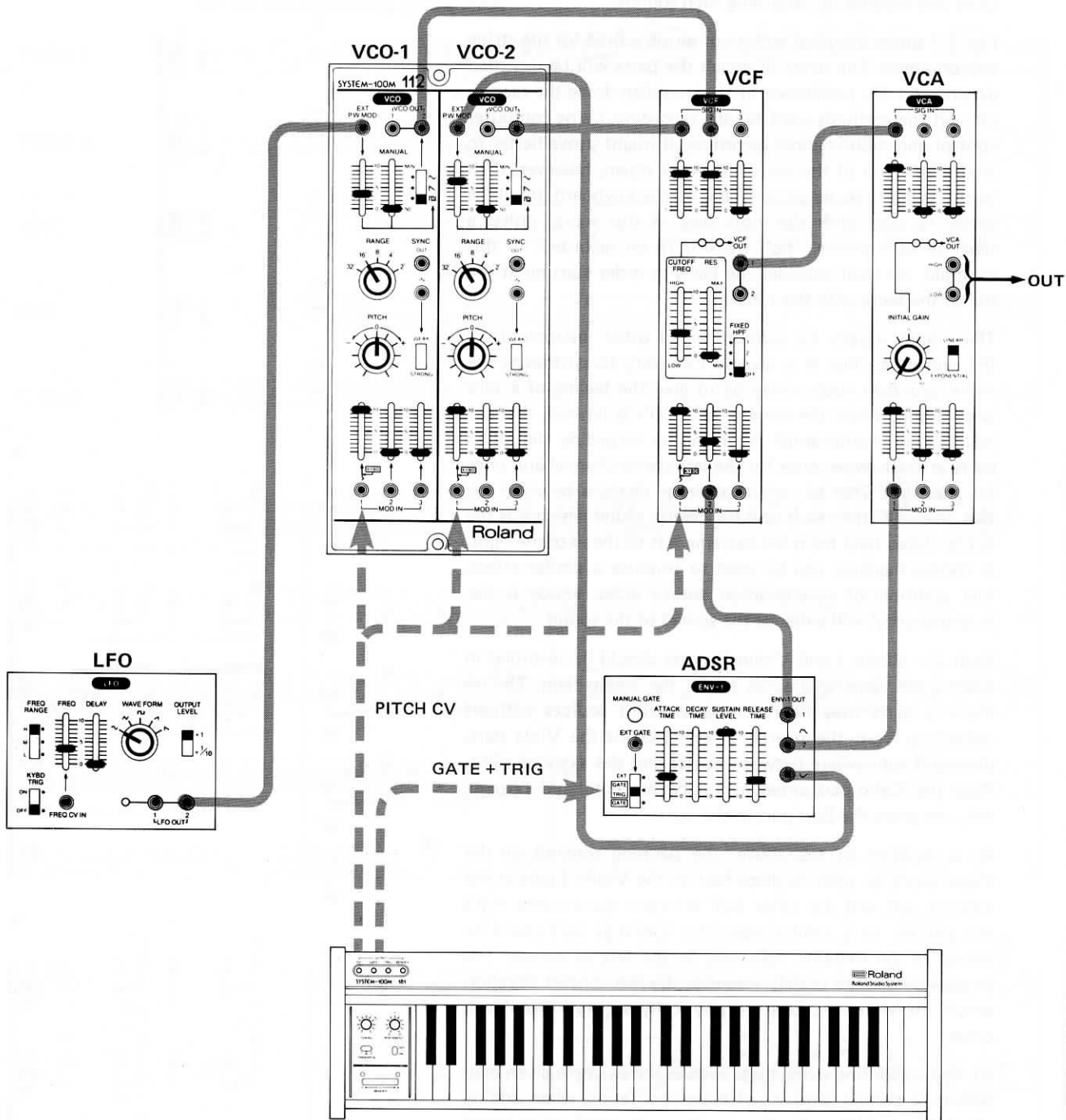
2-3 Recording the String Section

Recording techniques for string sounds can be important, particularly in stereo, because group sounds seldom originate from a point source. The following example will serve to show one method for recording such sounds.

Fig. 2-7 shows a typical section of music scored for the string section alone. The order in which the parts will be recorded depends on the preference of the musician doing the recording and the methods used for the recording. Using computer control and multichannel recording, it might prove better to start at the top of the score and work down; however, if all the parts are to be played by hand on the keyboard, it will be better to start with the viola part in this score, unless a separate metronome "tic" track is to be recorded. In this example, we shall consider the parts in order starting at the top of the score with the violin parts.

The violins usually far outnumber all other instruments in the orchestra, thus it is usually necessary to synthesize the violin sound in such a way as to give the feeling of a very large group. When the number of VCO's is limited, this can be done in multichannel recording by recording the violin parts at least twice, once for the left stereo channel and once for the right. Due to continual phase changes between the two channels, the result will be a violin sound which fills the entire stereo field from the extreme left to the extreme right. A chorus machine can be used to produce a similar effect. The addition of reverberation and/or echo, which is discussed shortly, will enhance the spread of the sound.

Both the Violin I and Violin II parts should be recorded in exactly the same way so as to fill the stereo field. The remaining parts may be recorded as point sources without detracting from the overall effect. Record the Viola part, placing it somewhere between center and the extreme right. Place the 'Cello part somewhere between center and extreme left, and place the Bass part in the center.

As a variation of the above, the panning controls on the mixer could be used to place half of the Violin I part at the extreme left and the other half between the extreme right and center. In a similar way, the Violin II part could be placed at the extreme right and to the left of center. The result would more closely resemble the live concert situation where the violin sections are physically separate from each other.

At first, recording string parts such as the example given may require a certain amount of experimentation when adding equalization. Many sounds may be quite good when heard alone, but change considerably when other sounds are added. It may prove necessary to slightly exaggerate the equalization so that each of the parts sounds correct after they are all mixed together. (Sample equalizer settings are shown in Fig. 4-4 of Volume 1).

Fig. 2-7 Typical score for strings

Peter and the Wolf
A Musical Tale

Andantino. ♩ = 92

Early one morning Peter opened the
gate and went out on a big green meadow.

Serge Prokofieff
1936

Op. 67

2-4   Reverberation and Echo for Group Strings

The addition of reverberation and/or echo to group string sounds is essential to the overall effect. Reverberation tends to reinforce the sound to increase the feeling of a large group of instruments. In multichannel recording, reverberation is usually added during the mix-down where it is easily controlled. Echo often proves better added during the recording of each part. Except for special effects, echo used with group sounds is usually better when added sparingly. For example, when the first violins leave one note for another, the hint of the remaining pitch echoed in the background can give the feeling of a very large string section. When the echo is added each time one of the groups is recorded, the echo rate can be changed slightly each time to increase the effect.

It may take a certain amount of experimentation to find the amount of echo which produces the desired effect without sounding exaggerated. For example, it may be decided to add a small amount of echo to the upper voices with little or no echo for the lower voices. A very fast echo added to reverberation often enhances the group effect.

2-5   Solo Pizzicato Sounds

Besides the obvious differences in envelopes, plucked string sounds differ from bowed string sounds in that the tone color of pizzicato notes is usually in constant change during the production of each note. This implies that envelope control of the VCF cutoff frequency must be used, and/or that the pulse waveform output of the VCO must be used with envelope control of the pulse width.

Fig. 2-8 shows a patch for a solo pizzicato violin sound. Besides the envelope, the major differences between this patch and the normal violin sound (see Fig. 2-1) is that the VCF cutoff frequency is set at minimum and controlled by the envelope generator so that the tone color will change during the production of each note. The VCA is set for its exponential mode to help give the sound a percussive effect.

Fig. 2-8 Pizzicato VIOLIN
ⓐ Block Diagram
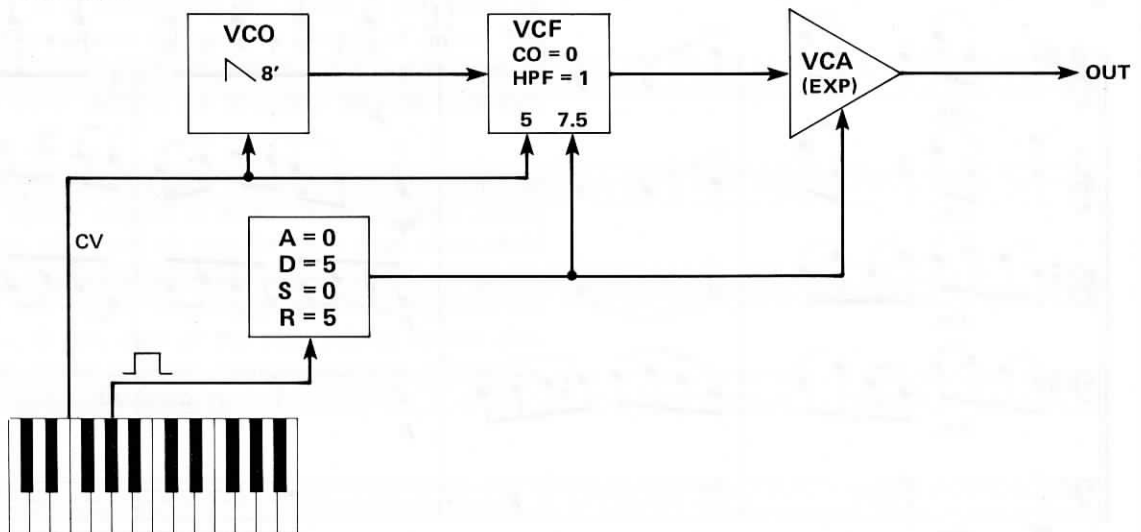
Fig. 2-8 (cont'd)

ⓑ Patch Diagram
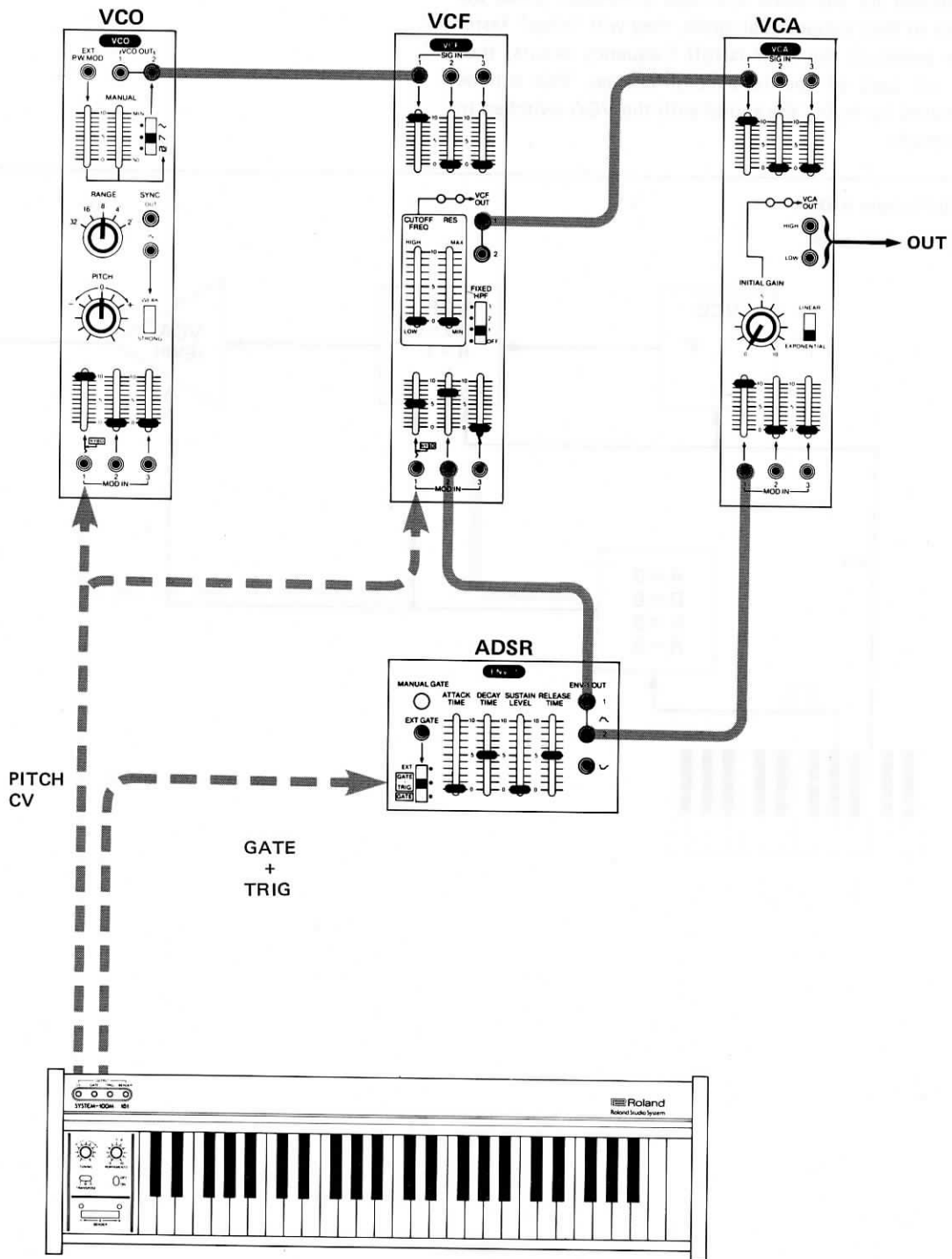
Fig. 2-9 shows a pizzicato viola sound which uses a slight amount of resonance and omits the high pass filter.

In the violin and viola sounds of above, the VCF and VCA are controlled by the same envelope generator. Since the VCA's are in their exponential mode, they will "close" faster than the sweep of the VCF cutoff frequency occurs, thus choking off part of the tone color change. This can be demonstrated by trying the sound with the VCA switched to its linear mode.

Fig. 2-9 Pizzicato **VIOLA**

ⓐ Block Diagram
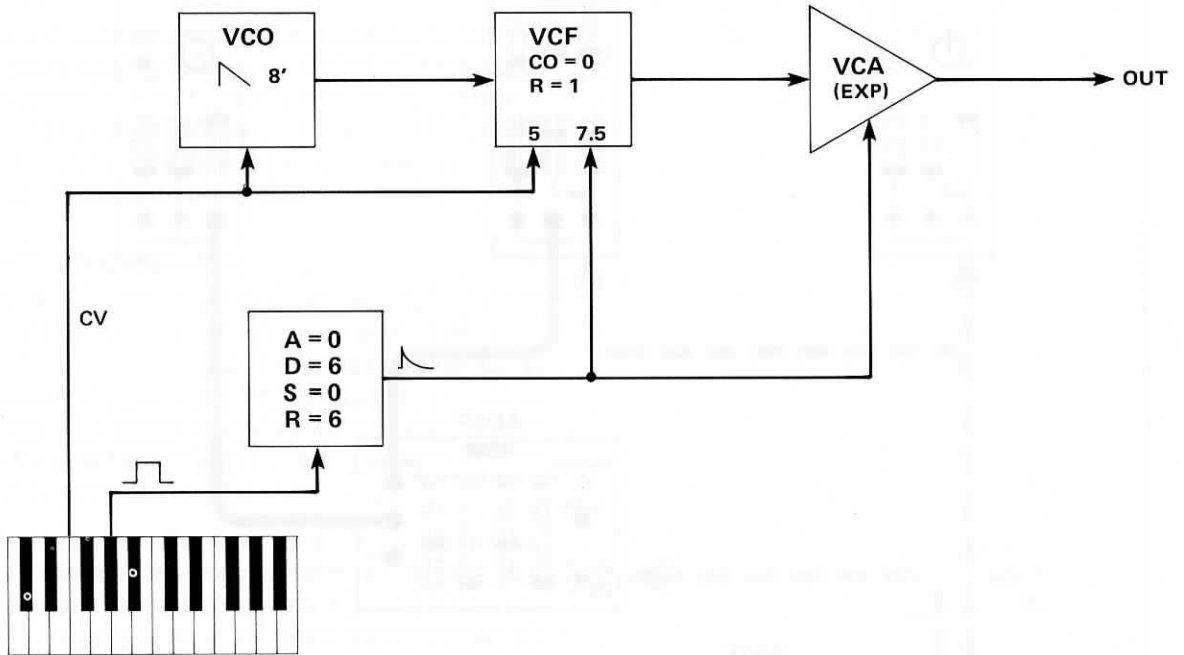
Fig. 2-9 Pizzicato VIOLA (cont'd)

ⓑ Patch Diagram
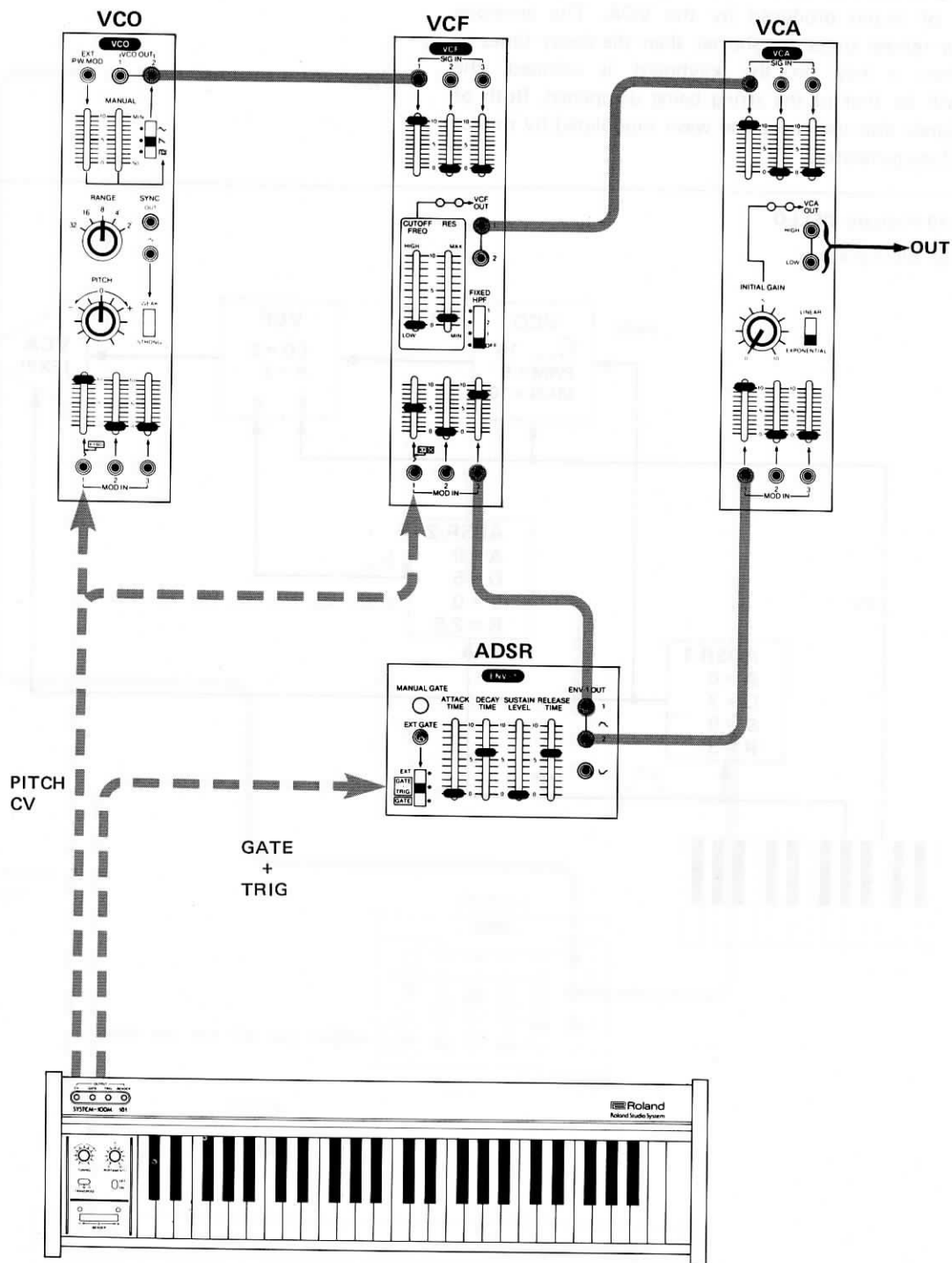
Fig. 2-10 shows a pizzicato 'cello sound and Fig. 2-11 shows a pizzicato bass sound. Both of these sounds use a second envelope generator with a slightly shorter decay time so that the sweep of the VCF cutoff frequency more evenly matches the fall of sound produced by the VCA. The envelope generator release times are shorter than the decay times so that when a key on the keyboard is released, the effect will be that of the string being dampened. Both of these sounds also use the pulse wave modulated by one of the envelope generators.

Fig. 2-10 Pizzicato 'CELLO
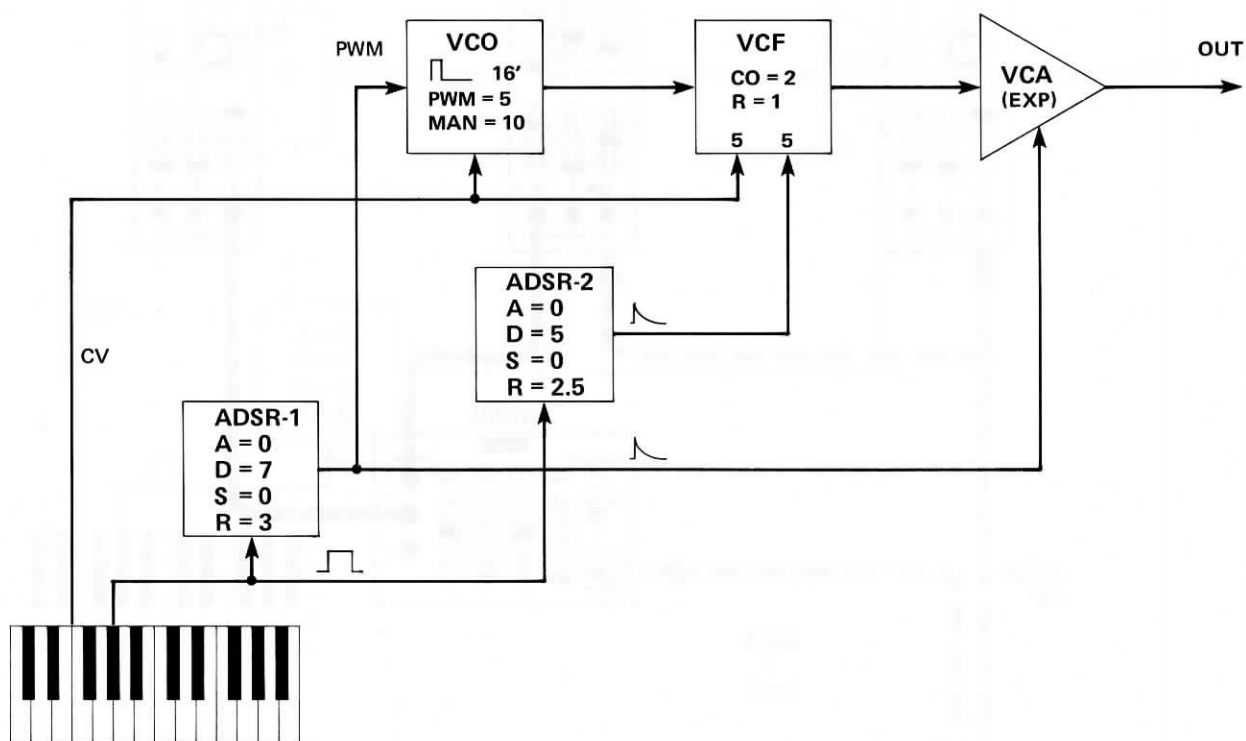
ⓐ Block Diagram

Fig. 2-10 Pizzicato 'CELLO (cont'd)

ⓑ Patch Diagram
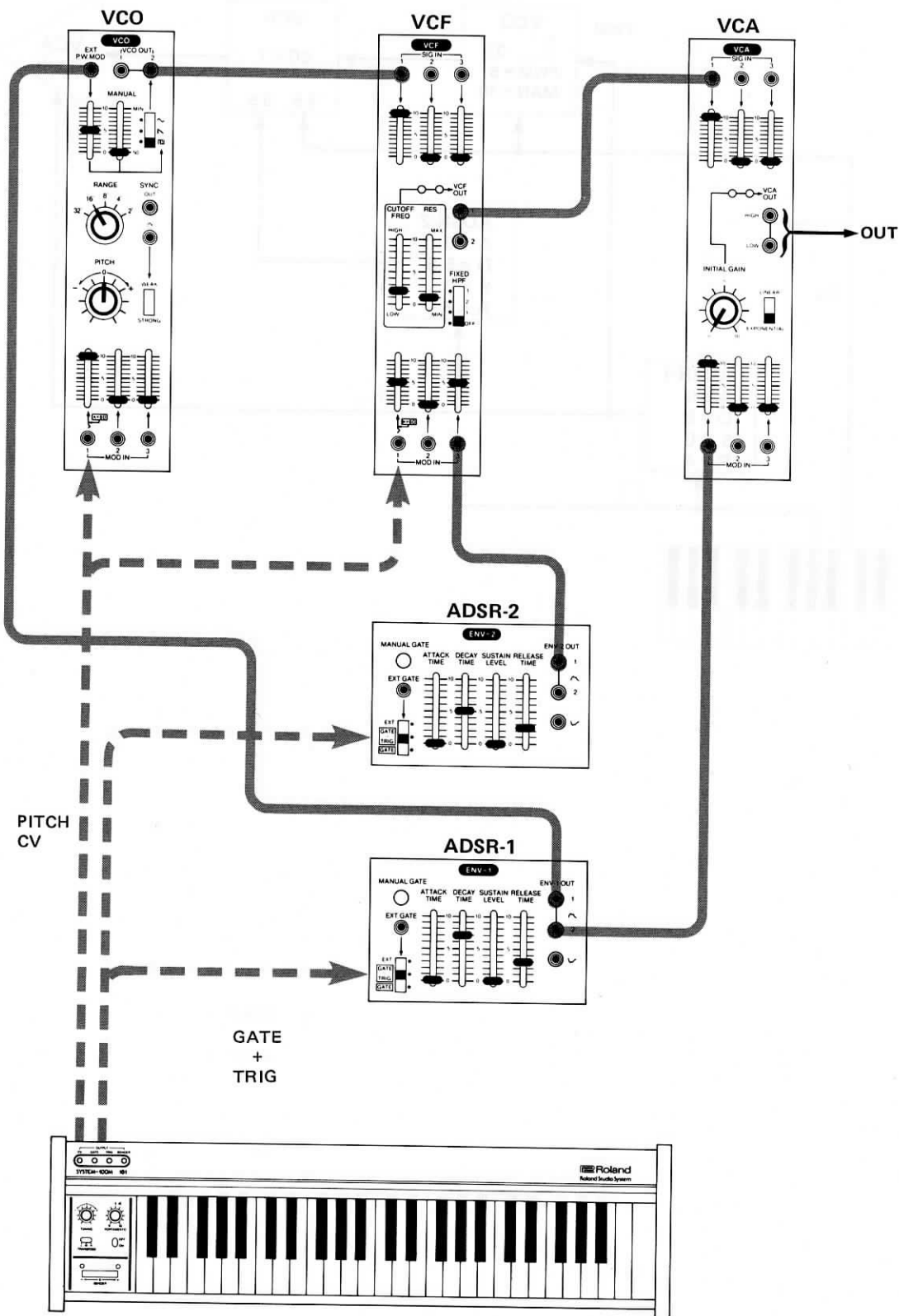
Fig. 2-11 Pizzicato **BASS**

ⓐ Block Diagram
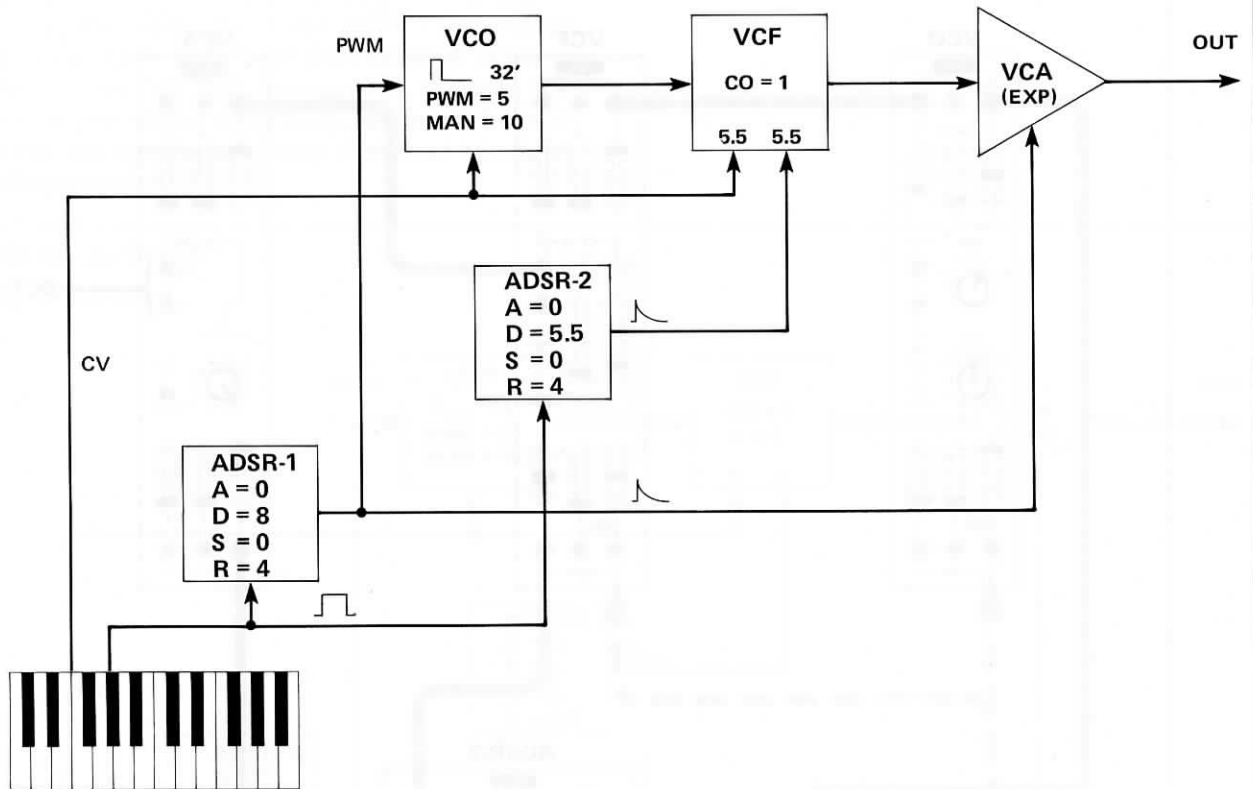
Fig. 2-11 Pizzicato BASS (cont'd)

ⓑ Patch Diagram
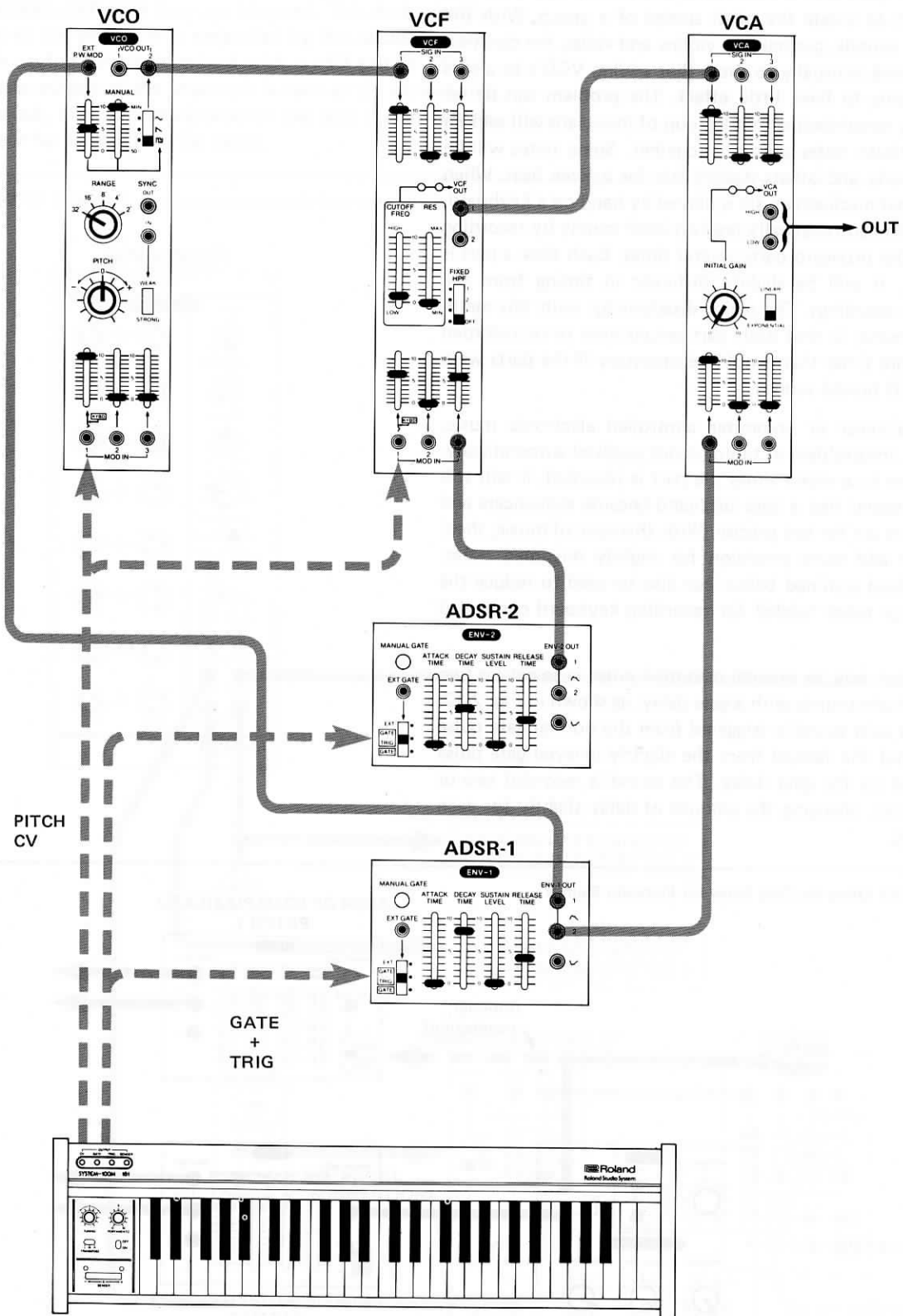
2-6 Group Pizzicato Sounds

The problem of creating group pizzicato sounds is different from that of group bowed strings. With bowed strings, we can often start with a solo sound and merely add VCO's to the patch to create the pitch spread of a group. With the pizzicato sounds, particularly violins and violas, the duration of each note is usually so short that adding VCO's to a solo patch seems to have little effect. The problem can be resolved by remembering that a group of musicians will seldom play pizzicato notes precisely together. Some notes will be slightly early and others slightly late for a given beat. When synthesized pizzicato music is played by hand on a keyboard, the problem automatically resolves itself merely by recording each of the pizzicato parts several times. Each time a part is recorded, it will be slightly different in timing from the previous recordings. The major disadvantage with this method, of course, is that each part would have to be recorded many more times than would be necessary if the parts were multi-VCO bowed sounds.

With sequencer or computer controlled electronic music, however, the problem of timing is not resolved automatically. No matter how many times the part is recorded, it will still tend to sound like a solo pizzicato because sequencers and computers are far too precise. With this type of music, then, we must add some provision for slightly mistimed notes. The method outlined below can also be used to reduce the number of times needed for recording keyboard controlled music.

The easiest way to provide mistimed notes is to set up two solo pizzicato sounds with a gate delay, as shown in Fig. 2-12. The first solo sound is triggered from the normal gate pulse source and the second from the slightly delayed gate pulse generated by the gate delay. The sound is recorded two or three times, changing the amount of delay slightly for each recording.

Fig. 2-12 Using the Gate Delay for Pizzicato Sounds

ADSR OF SOLO PIZZICATO PATCH 1.

ADSR OF SOLO PIZZICATO PATCH 2.

Vary this setting slightly each time the pizzicato part is recorded.
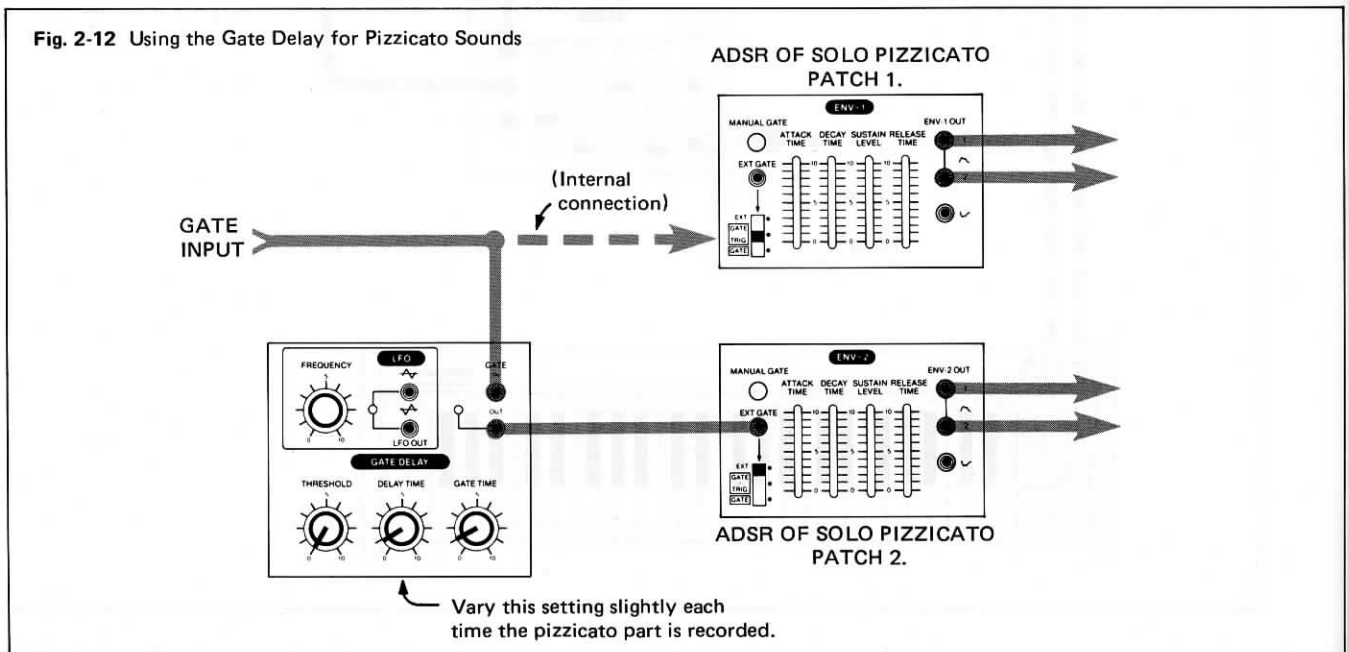
A better way to do this is to use a sequencer, as shown in Fig. 2-13. For sequencer controlled music, this means that a second sequencer is required. This is better than the gate delay because it provides different timings between the two solo sounds each time they are triggered. The clock rate (or speed) of the sequencer is controlled by the random output of the sample and hold mixed with a +10 voltage source. The gate output of the sequencer is used as the sample and hold clock, thus the timing between the solo sounds will be different for each note in the music.

Fig. 2-13 Triggering group pizzicato sounds (two sounds)

SEQUENCER

SYSTEM-100M 182

TO ADSR GATE INPUT OF
SOLO PIZZICATO PATCH 1.

GATE
INPUT

TO ADSR GATE INPUT OF
SOLO PIZZICATO PATCH 2.

SAMPLE AND HOLD

MIXER

NOISE

(INTERNAL
CONNECTION)

Set this slider so speed of
sequencer produces desired
effect.
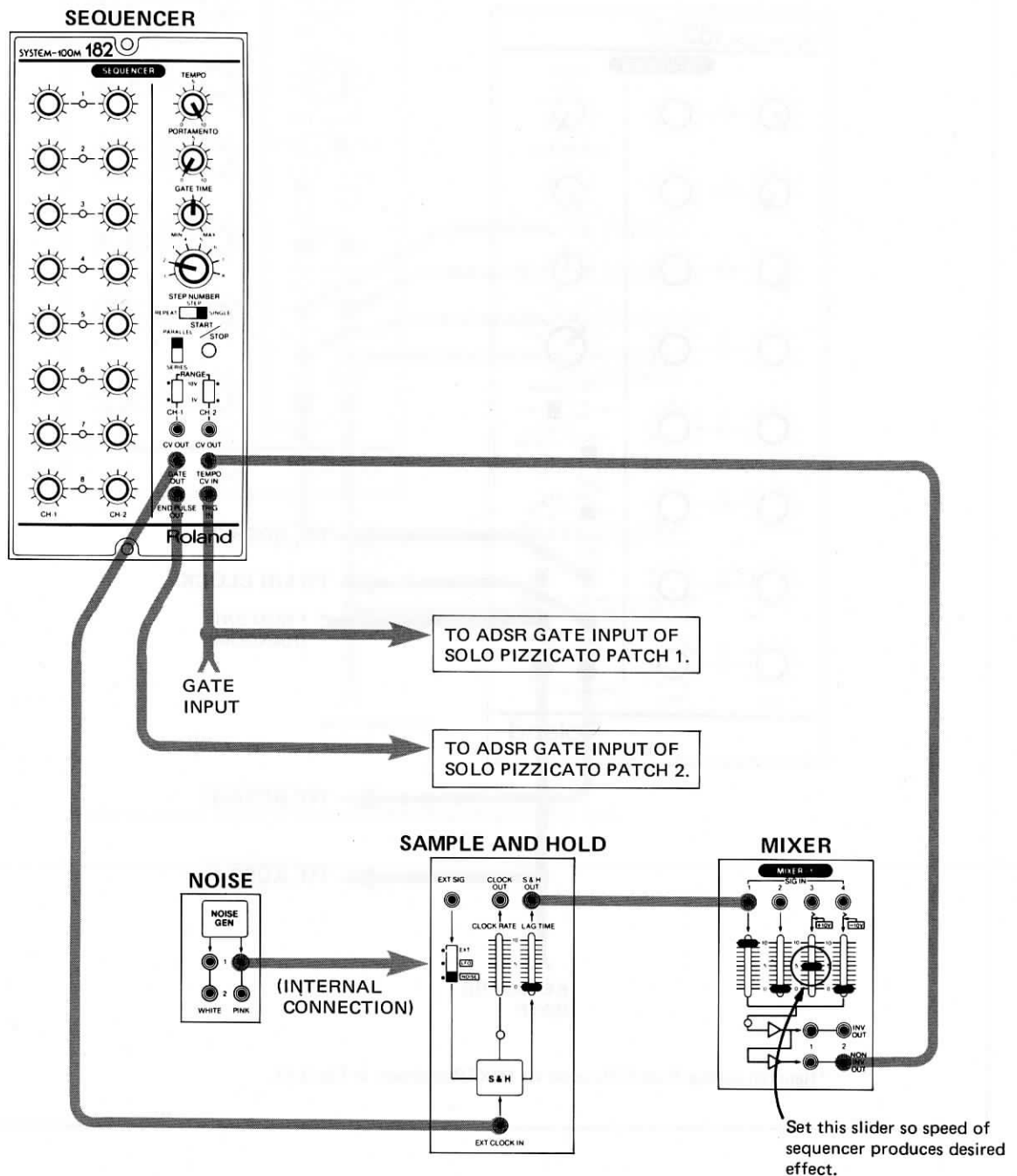
It is possible to trigger three solo pizzicato sounds by setting the sequencer as shown in Fig. 2-14. In this case the channel 1 voltage registers are set so that the CH-1 CV OUT produces a gate pulse at Step 2 in the sequence. This gate pulse is used to trigger the third solo sound. A fourth solo sound can be triggered by using the CH-2 CV OUT as shown in Fig. 2-15. When using more than two solo sounds, it may be necessary to cause the sequencer to run a little faster by slightly raising the +10v input to the mixer to get the correct effect.

Fig. 2-14 Triggering group pizzicato sounds (three sounds)
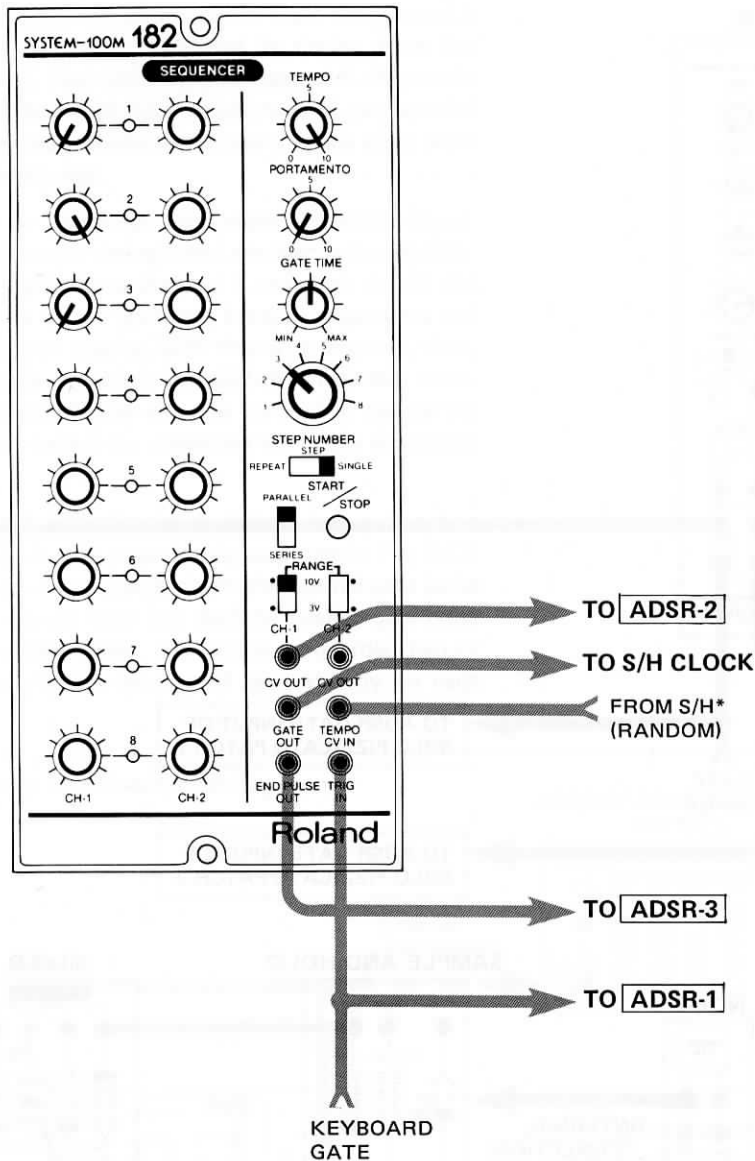
*Random voltage from S/H comes via MIXER as shown in Fig. 2-13.

Fig. 2-15 Triggering group pizzicato sounds (four sounds)

TO ADSR-2

TO ADSR-3

TO S/H CLOCK

FROM S/H*
(RANDOM)

TO ADSR-4

TO ADSR-1

KEYBOARD
GATE
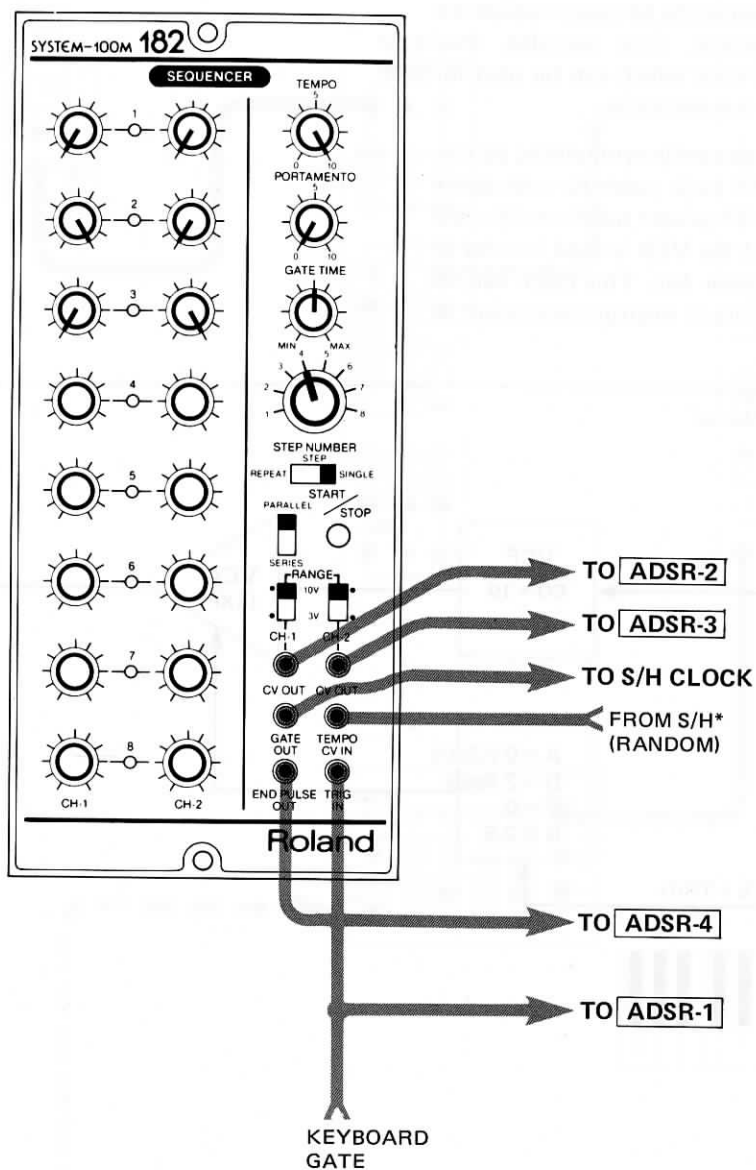
*Random voltage from S/H comes via MIXER as shown in Fig. 2-13.

Chapter Three:
Rhythm and Effects

3-1 Introduction

Rhythm is the soul of music. Indeed, the very backbone of most forms of popular music is the rhythm section. In multi-channel recording of popular music the percussion voices are very often recorded first because, once recorded, they become a built-in metronome track which can be used for recording the remaining parts.

Noise is a common sound source used in synthesizing percussion sounds. Fig. 3-1 shows the basic patch for subtractive synthesis in which a noise source has been substituted for the VCO. The exponential mode of the VCA is used in order to give the sound a more percussive feel. This patch can be effectively used for a rhythm voice in electronic music just as it appears in the diagram.

Fig. 3-1 Basic Percussion Patch (Noise)

ⓐ Block Diagram
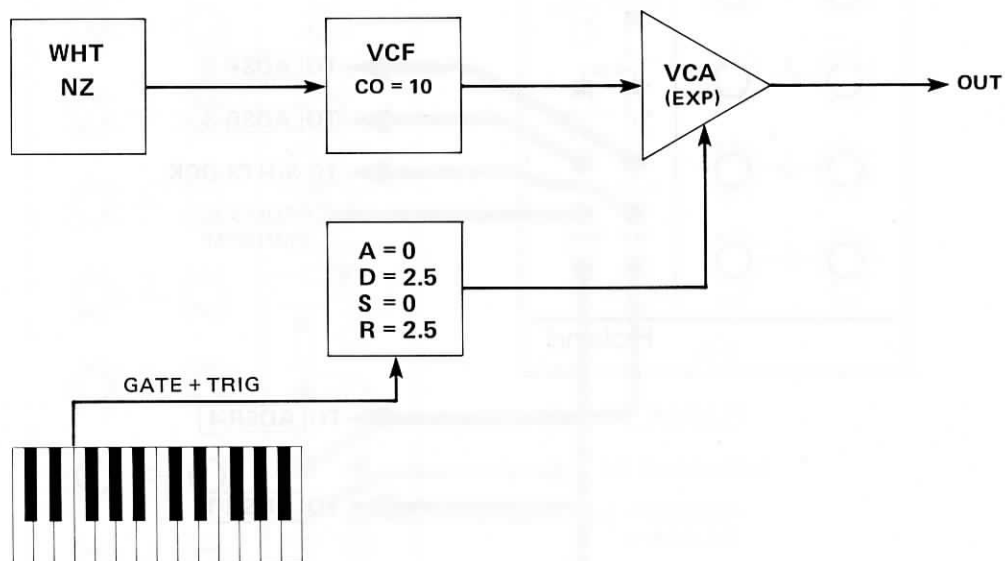
Fig. 3-1 (cont'd)

ⓑ Patch Diagram
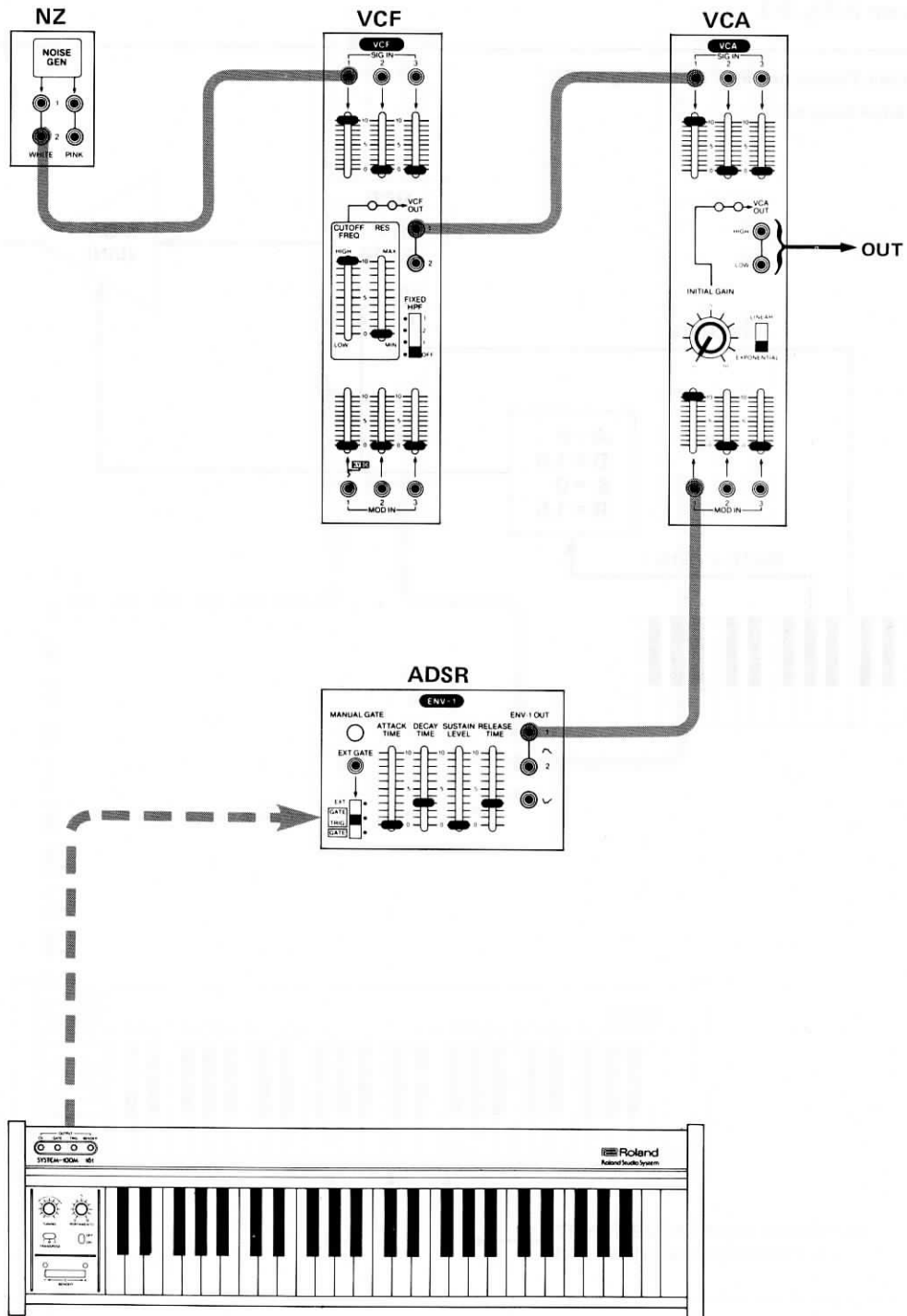
Fig. 3-2 shows another basic percussion patch which uses an oscillating VCF as the sound source. In this sound, the keyboard control voltage has been added to control the pitch of the drum sound. Try this sound with the rhythmic pattern shown in Fig. 3-3.

Fig. 3-2 Basic Percussion Patch (Oscillating VCF)

   (a) Block Diagram

Fig. 3-2 (cont'd)

ⓑ Patch Diagram

TRY THESE PITCHES USING THE
PATTERNS SHOWN IN FIG. 3-3.
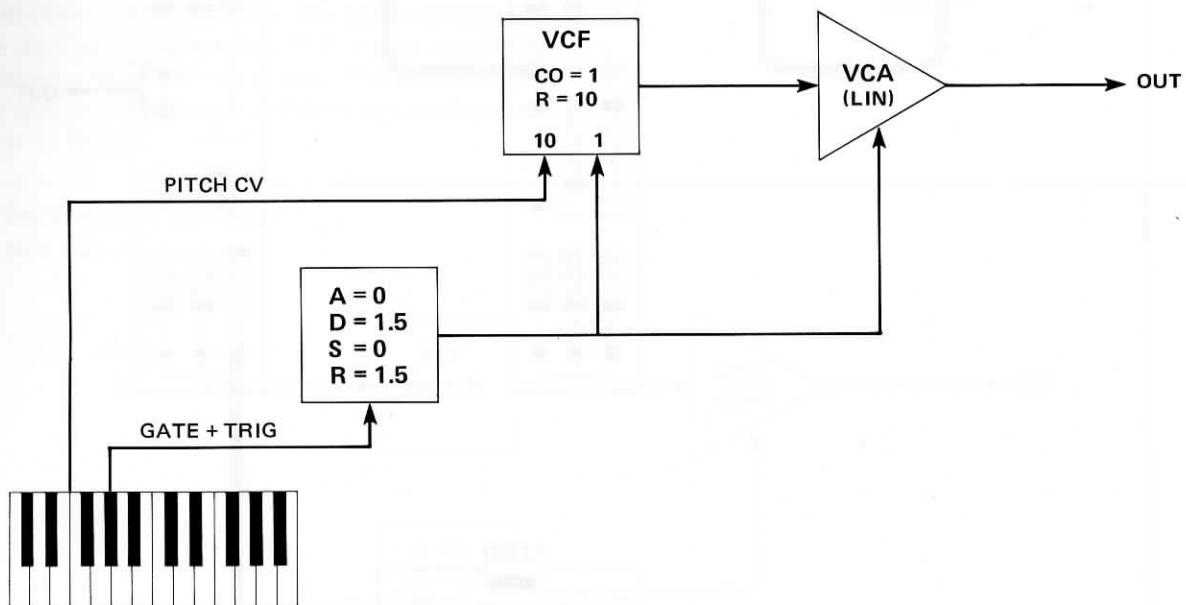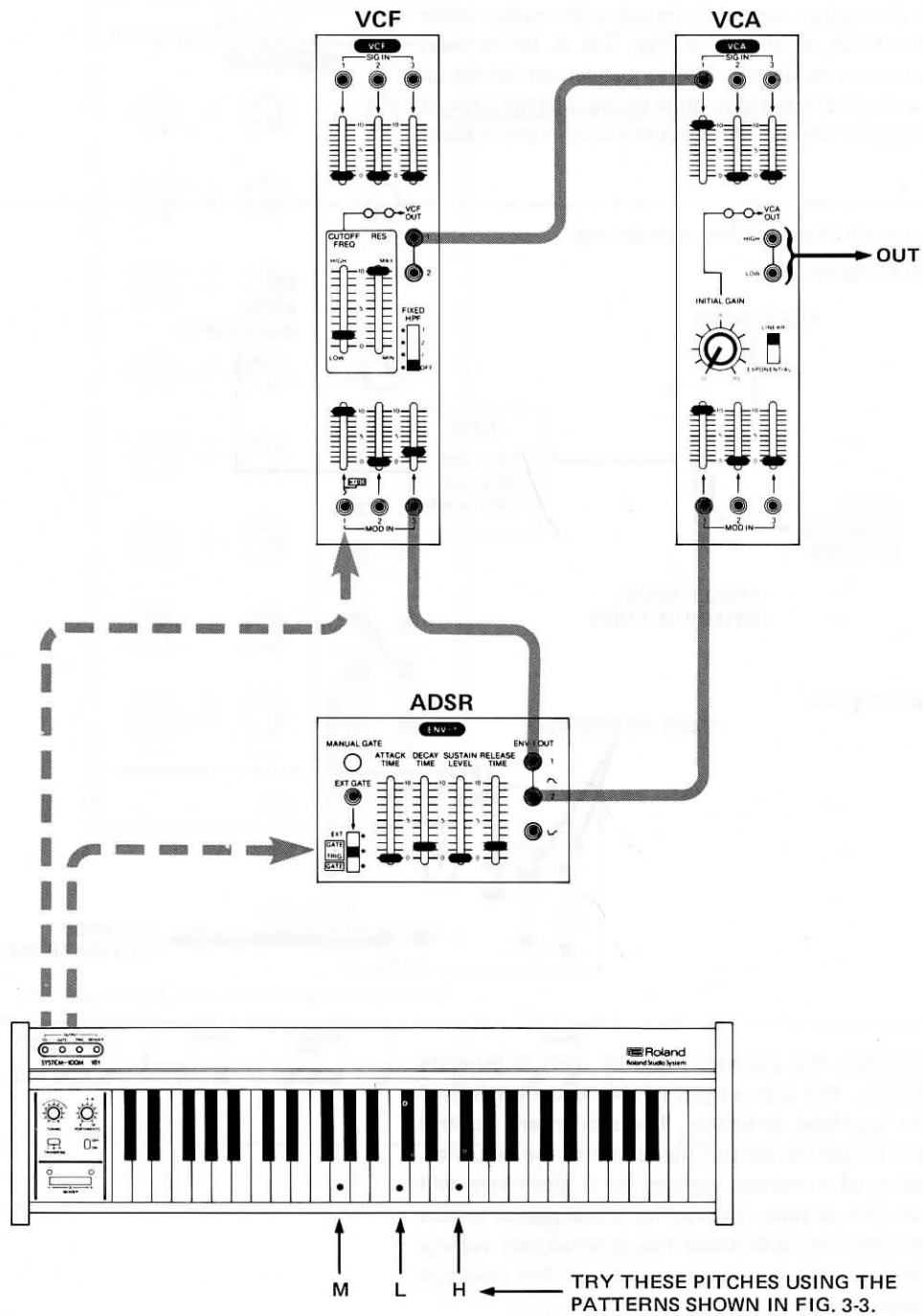
Fig. 3-3 Rhythm Pattern

High
Medium
Low

3-2   Triggering Percussion Voices

When synthesizing sounds, it is often desirable to set up
some form of automatic trigger so as to leave both hands free
to experiment with the control settings. The easiest way to
do this with percussion sounds is by using the square wave
output of the LFO, as shown in Fig. 3-4. A better way,
however, is to use a sequencer. The sequencer can be set up
to produce a rhythmic pattern, thus giving a better idea of
what the percussion voices will sound like within the context
of a pattern.

Fig. 3-4 Automatic Trigger for Percussion Sounds

ⓐ Block Diagram

FREQUENCY

TO
ADSR
GATE INPUT

FR = 4M

LFO
FR = 4M
DEL = 0
LEV = X1

FREQ
CONTROL
SETTING

FREQ RANGE
SWITCH SETTING

ⓑ Patch Diagram

SET AS DESIRED

LFO

LFO

FREQ FREQ DELAY WAVE FORM OUTPUT
RANGE   LEVEL

KYBD
TRIG

FREQ CV IN   LFO OUT

TO ADSR
EXT GATE INPUT
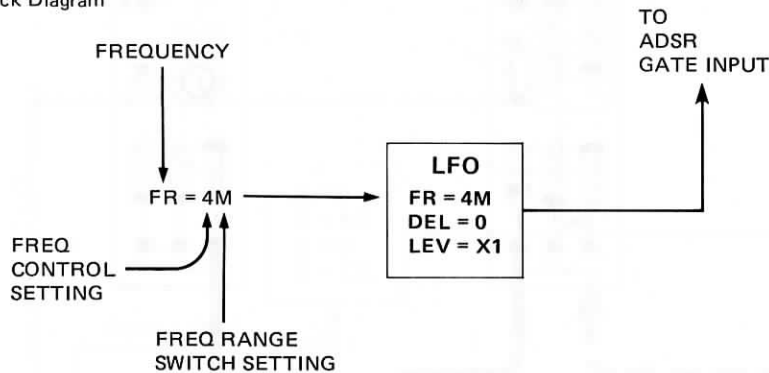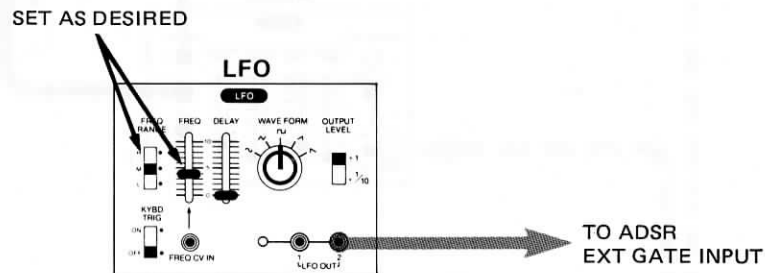
Fig. 3-5 shows how the sequencer can be used to generate
rhythmic patterns. The gate output of the sequencer is used
to trigger the envelope generator. The sequencer's control
voltage output is used to control the tempo of the sequence,
thus the setting of a voltage register for a given step will
govern the amount of time required for the sequence to pass
through that step. Fig. 3-6 shows the approximate voltage
register settings needed to produce some of the common
note time values.

Fig. 3-5 Using a Sequencer to Produce Rhythm Patterns

VOLTAGE REGISTERS

SET TEMPO AS DESIRED

TO ADSR
EXT GATE INPUT
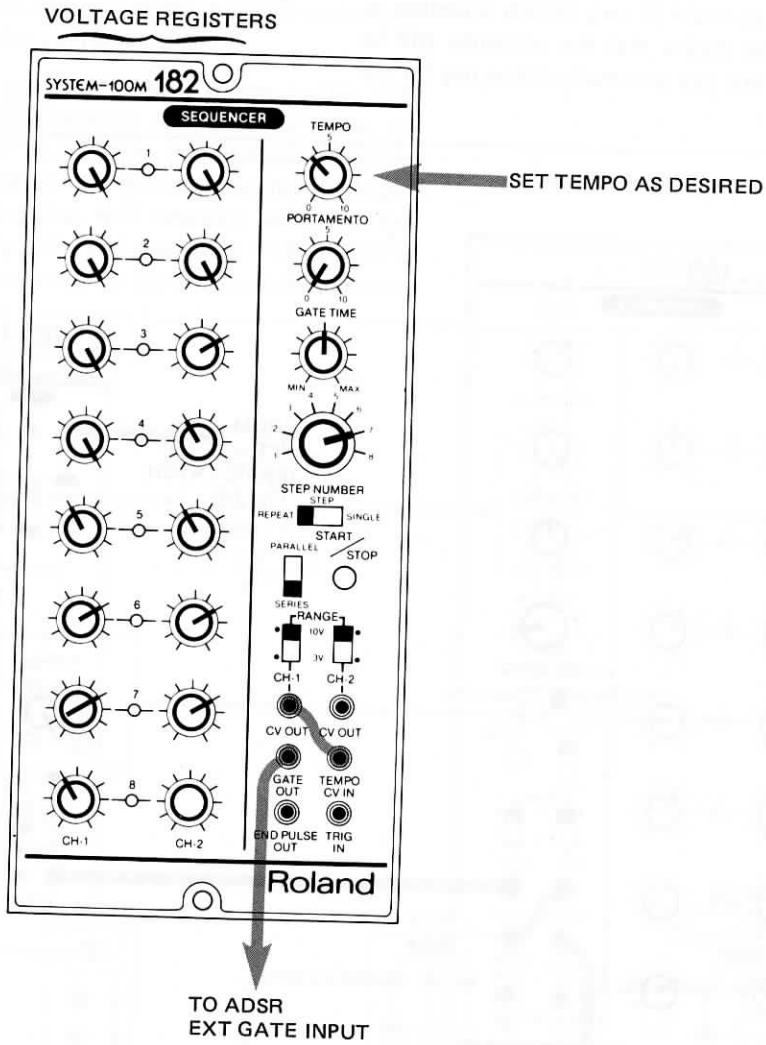
SET AS ABOVE, THE RHYTHM PATTERN IS:

Fig. 3-6 Voltage Register Settings for Common Time Values

IF ... (with RANGE switches set as "3V")

THEN:
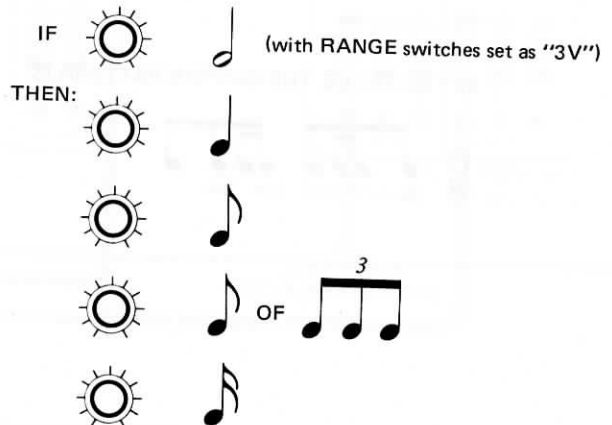
A major secondary advantage to using a sequencer is that one of the control voltage outputs can be used for adding dynamics to the pattern to make it very natural sounding, as shown in Fig. 3-7. This means that the sequence will be limited to eight notes, but this is a small price to pay for the effect produced.

Fig. 3-7 Using the Sequencer to Add Dynamics
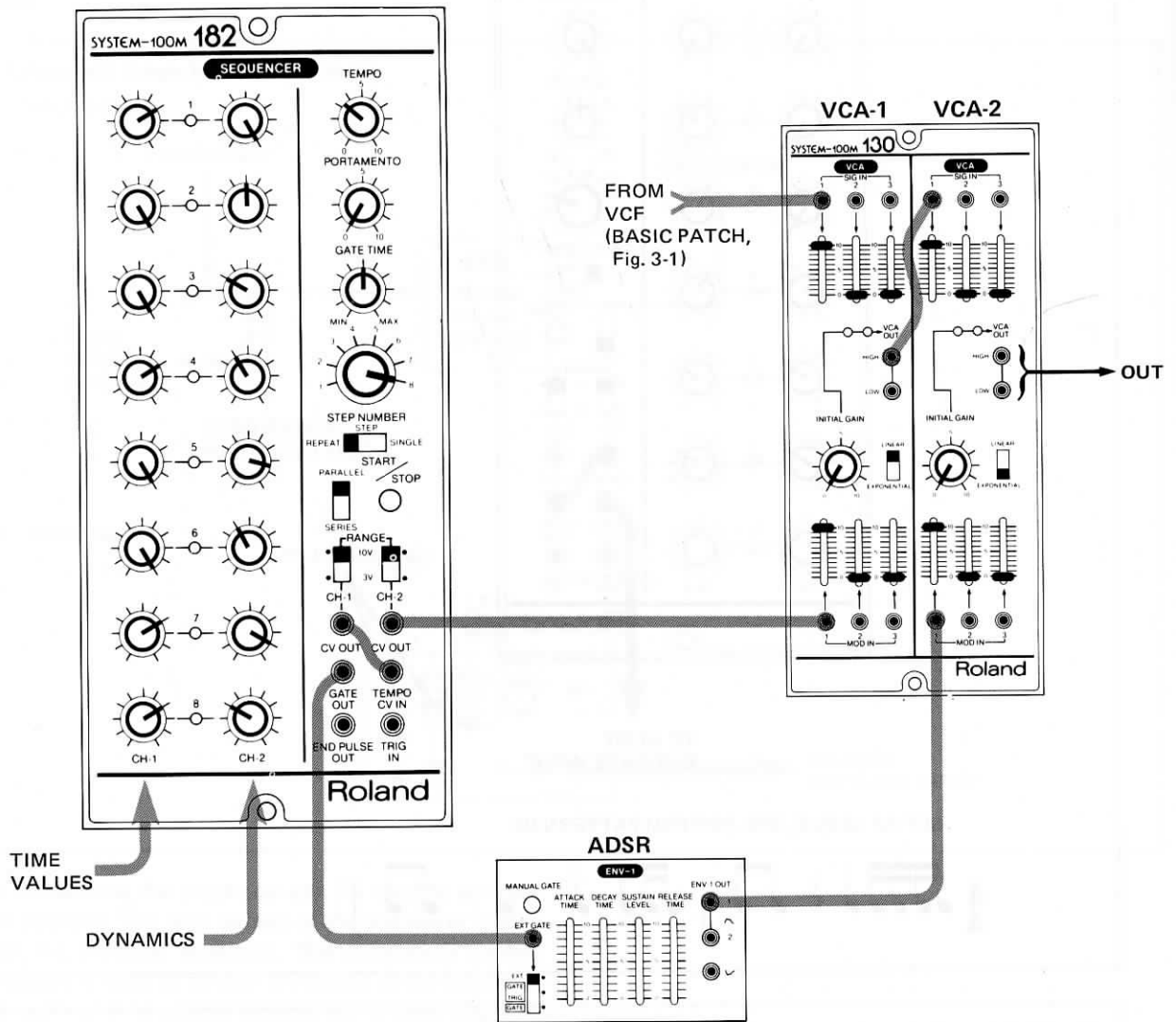
SET AS ABOVE, THE RHYTHM PATTERN IS:

3-3 Other Percussion Voices

Set up the patch shown in Fig. 3-7 and use it as a basis for the sounds which follow. Use one of the rhythmic and accent patterns shown, or devise a different one.

Start with the basic percussion patch shown in Fig. 3-1. First, raise the VCF RESONANCE control to "5". Next, set the HPF switch to "3". Last, raise the envelope generator ATTACK control to about "1". The result is like the sound of sand or seeds in a gourd. Add envelope control to the VCF, as shown in Fig. 3-8 (and lower the VCF CUTOFF FREQ control to compensate), for the sound of the maracas.

Fig. 3-8 MURACAS

ⓐ Block Diagram
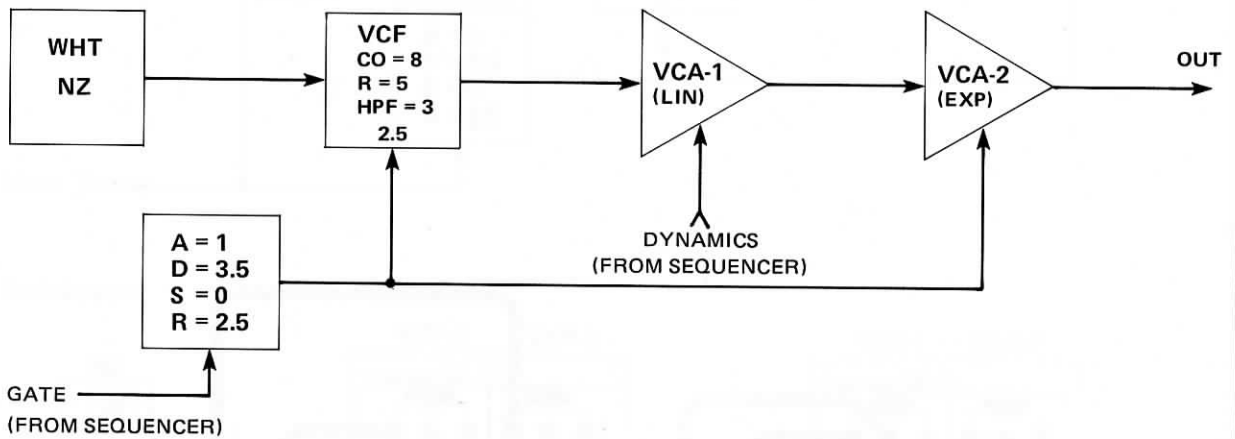
ⓑ Patch Diagram
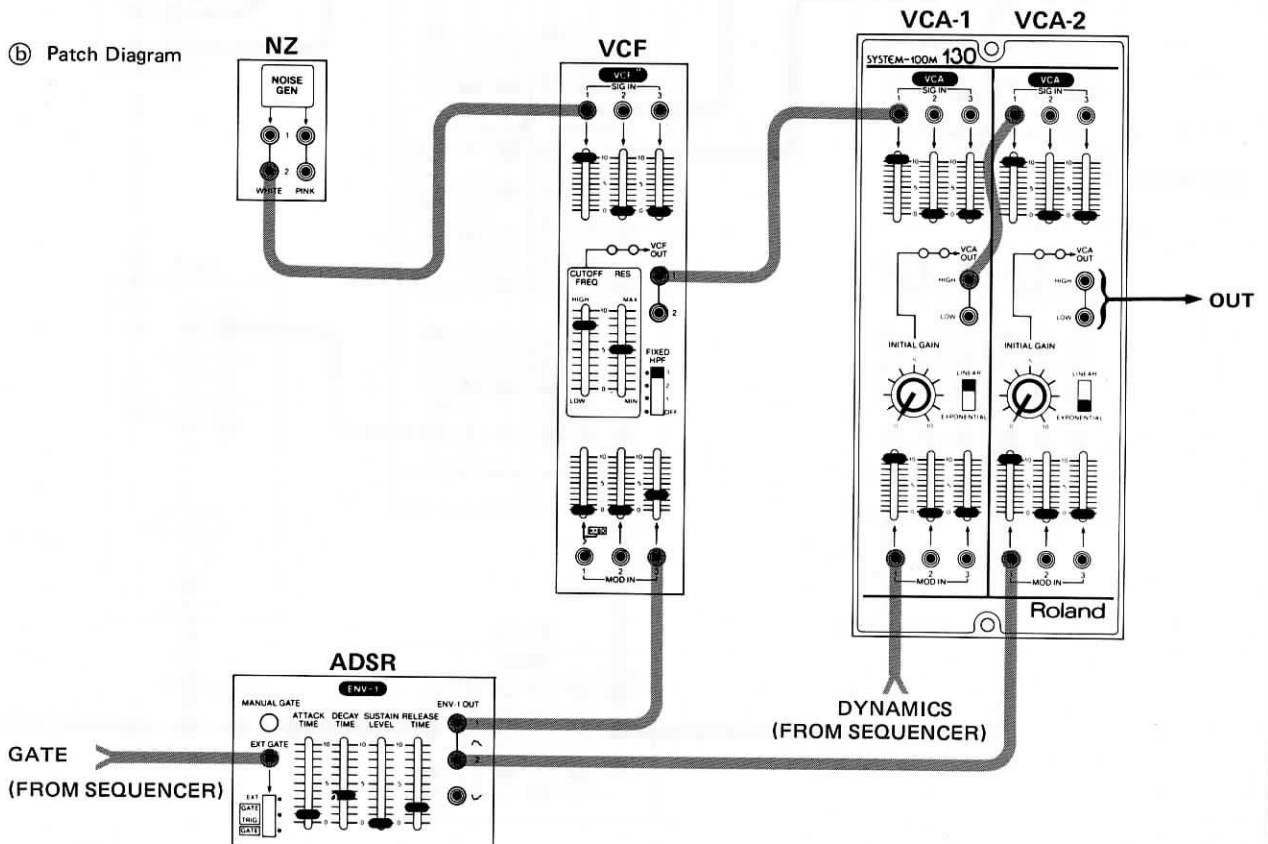
Fig. 3-9 shows how to synthesize a hand-clap sound. VCF-1 forms the resonant popping sound produced if the hands are cupped slightly when clapping. The random output of the sample and hold is used to alter the VCF cutoff frequency to imitate the random changes which occur in the sound due to changes in the size of the air cavity created by the hands.

Fig. 3-9 HAND-CLAP Sound

ⓐ Block Diagram
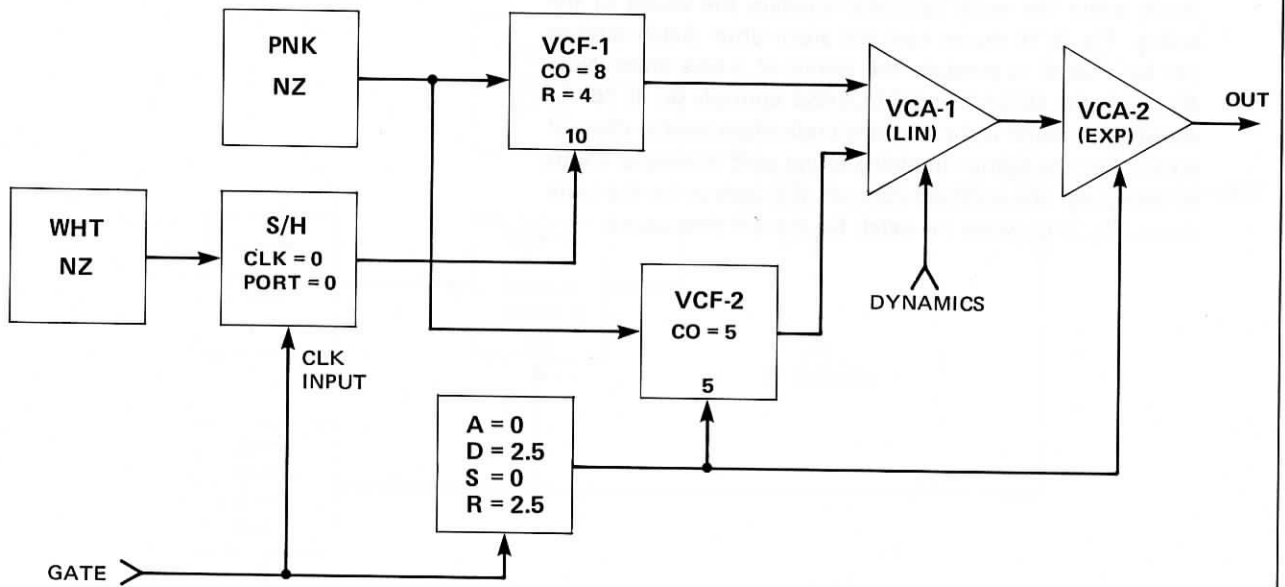
ⓑ Patch Diagram
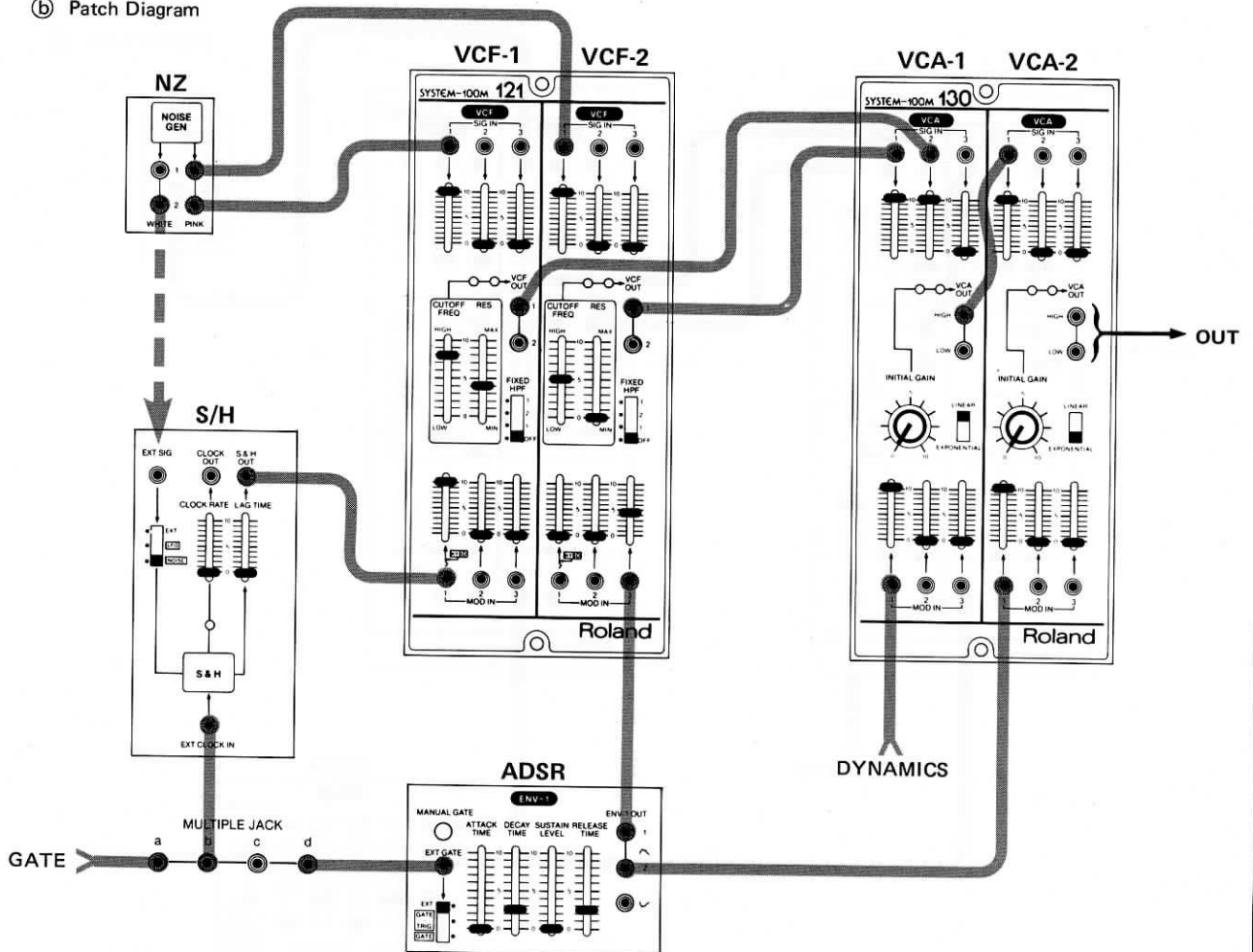
Fig. 3-10 shows a snare drum sound which uses both a noise generator and an oscillating VCF as sound sources. The oscillating VCF supplies the tone produced by the drum itself, while the noise generator supplies the sound of the snares. Fig. 3-11 shows how the snare drum patch settings can be altered to produce the sound of a bass drum. Note that with the DECAY and RELEASE controls set at "6" as shown, the sound is the lingering crash often used in classical music. For the tighter thudding sound used in popular forms of music, set the envelope controls the same as for the snare drum. Fig. 3-12 shows the patch for the rim shot sound.
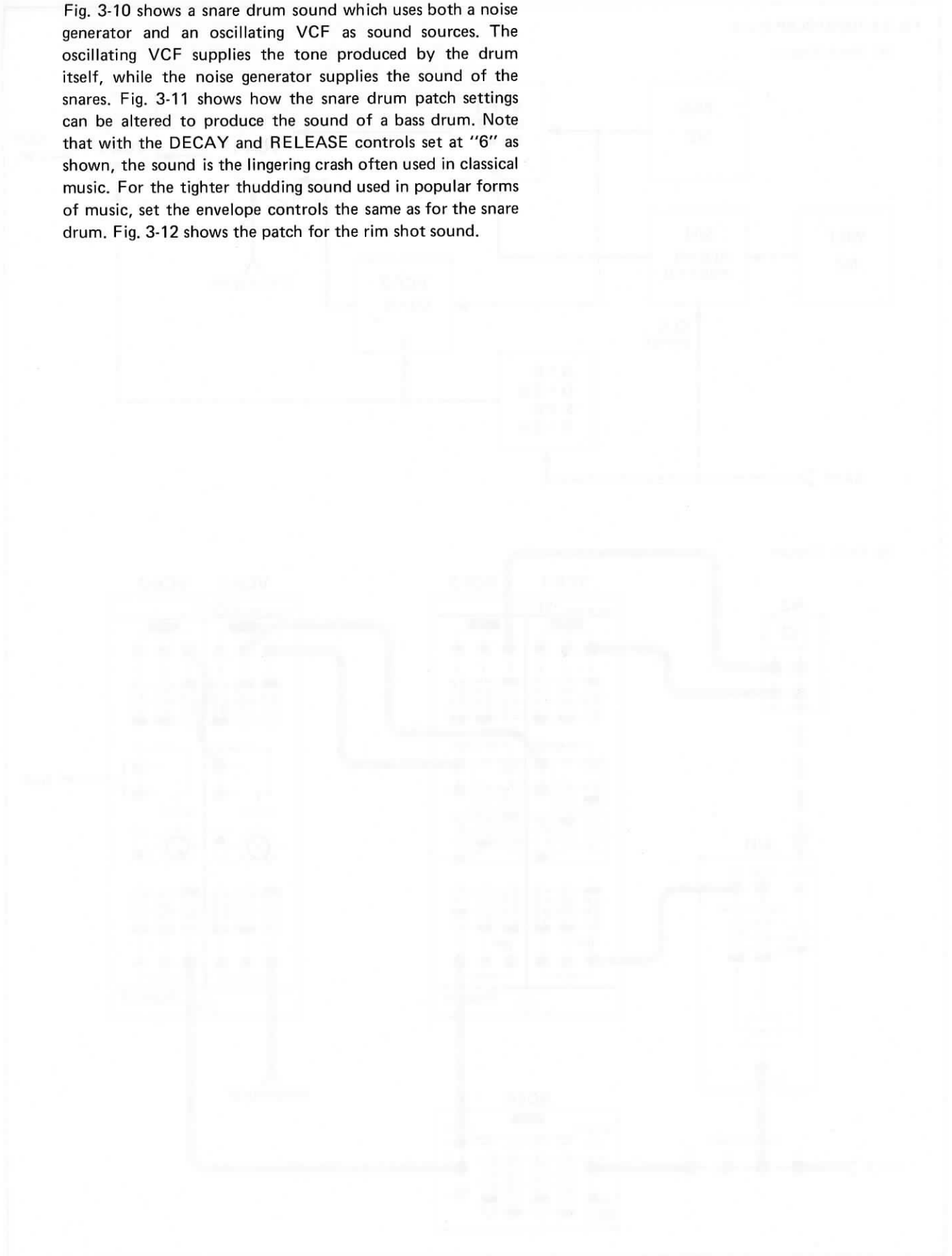
Fig. 3-10 SNARE DRUM
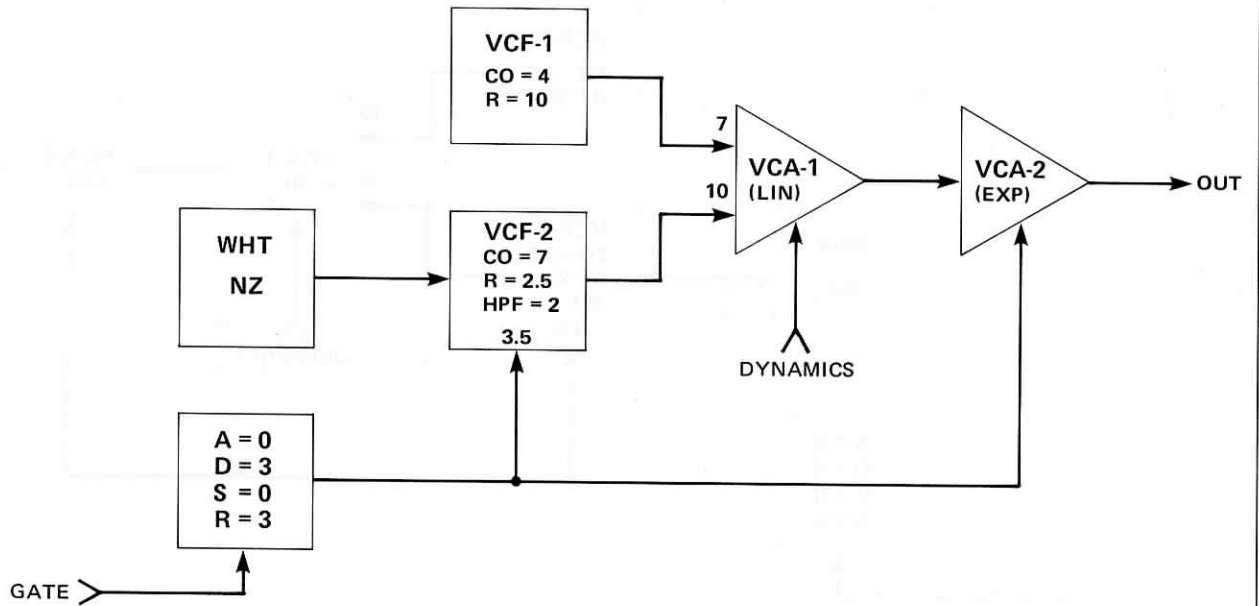
ⓐ Block Diagram
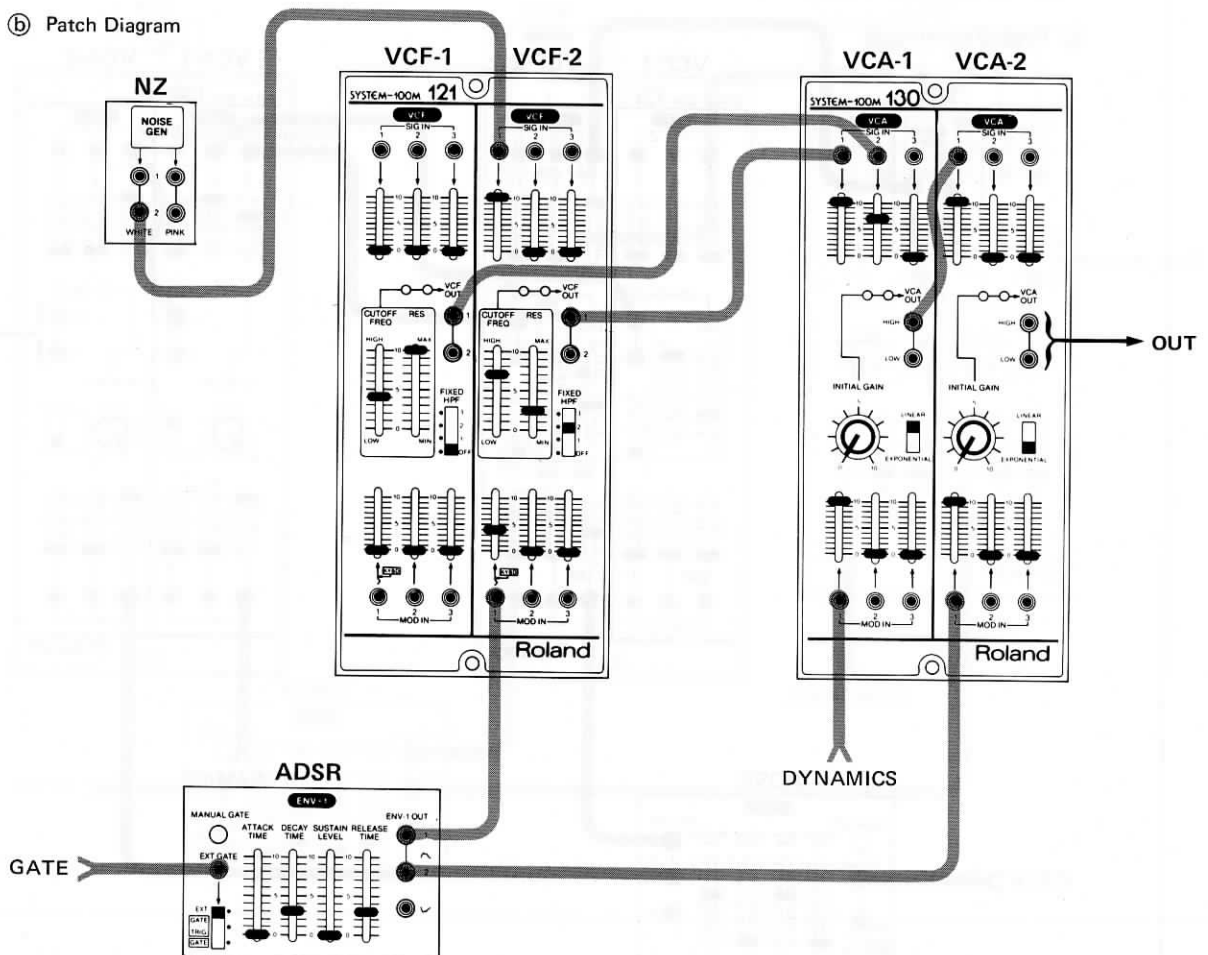
ⓑ Patch Diagram

Fig. 3-11 BASS DRUM

(a) Block Diagram
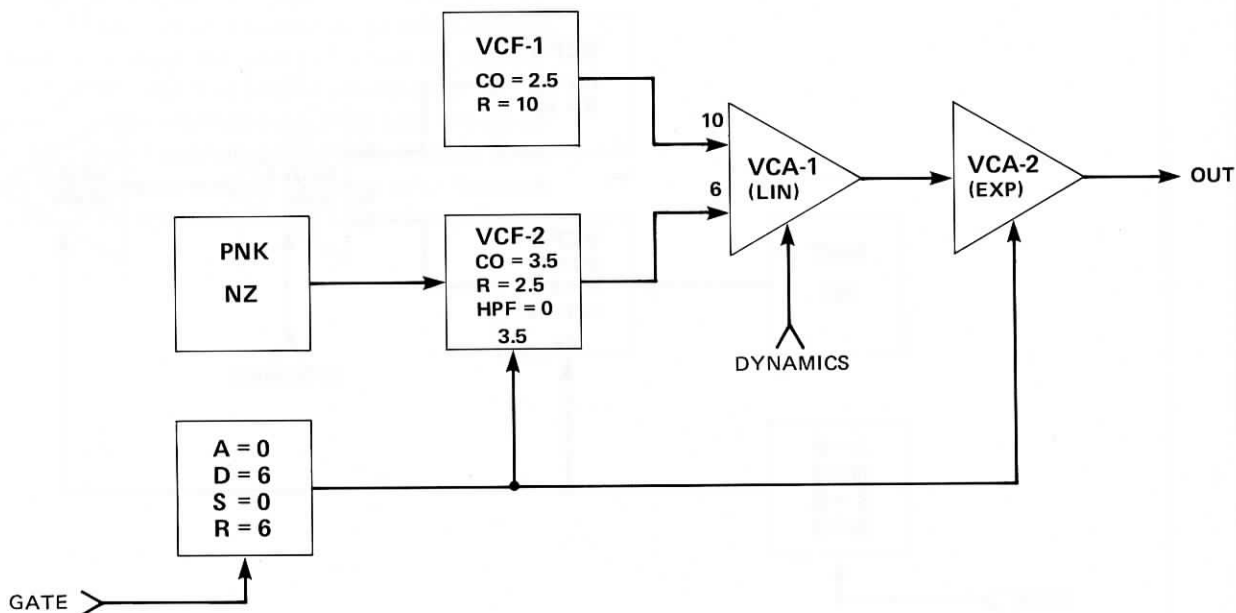
(b) Patch Diagram
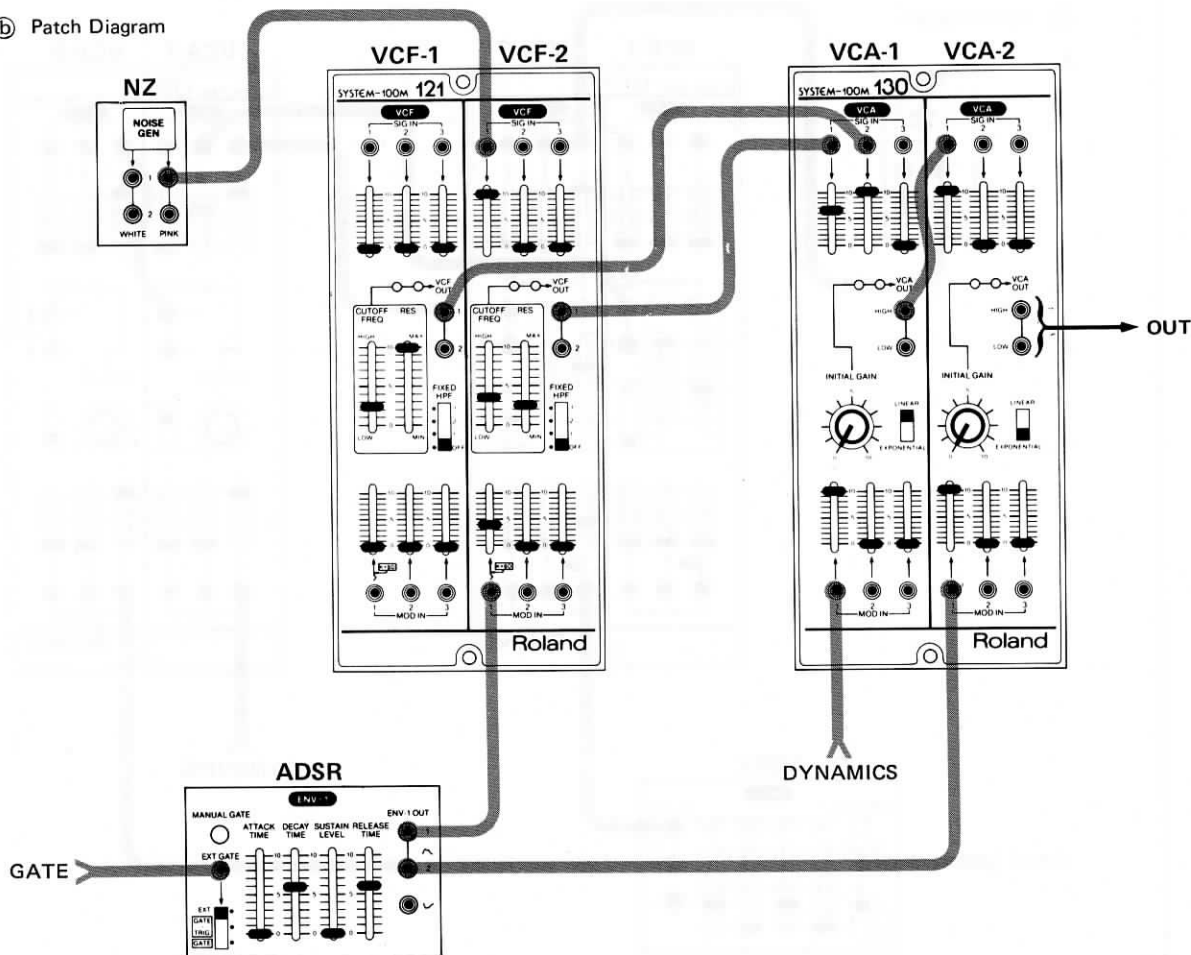
Fig. 3-12 RIM SHOT

ⓐ Block Diagram
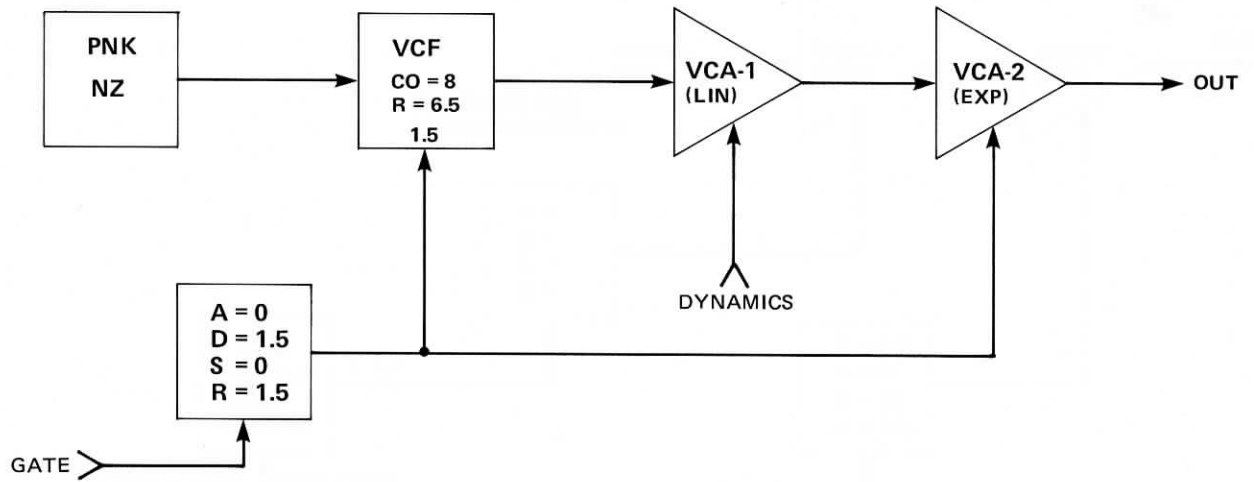
ⓑ Patch Diagram
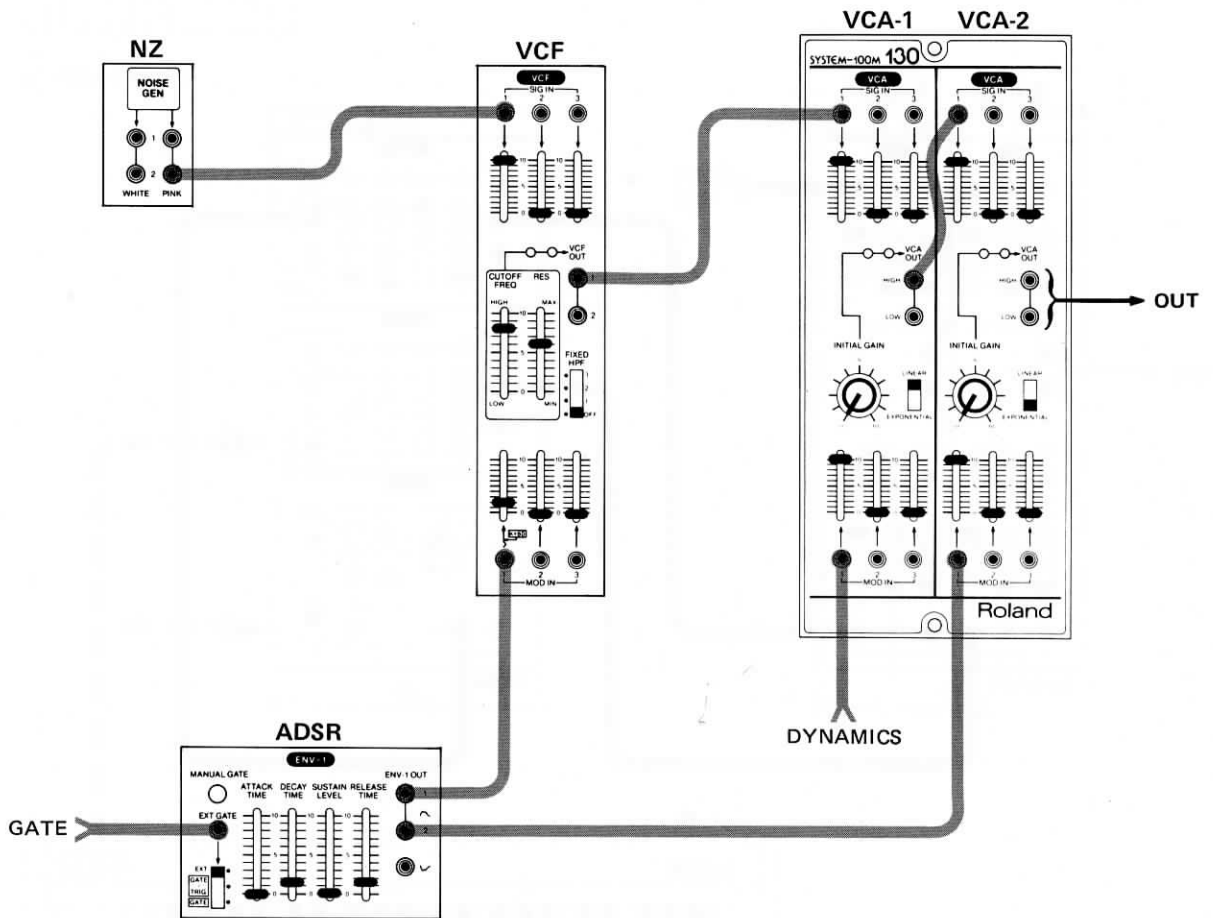
A trill for percussion sound can be produced by triggering the envelope generator with the square wave output of an LFO, as shown in Fig. 3-13. A second envelope generator/VCA combination is used as a gate to turn the trill on and off.
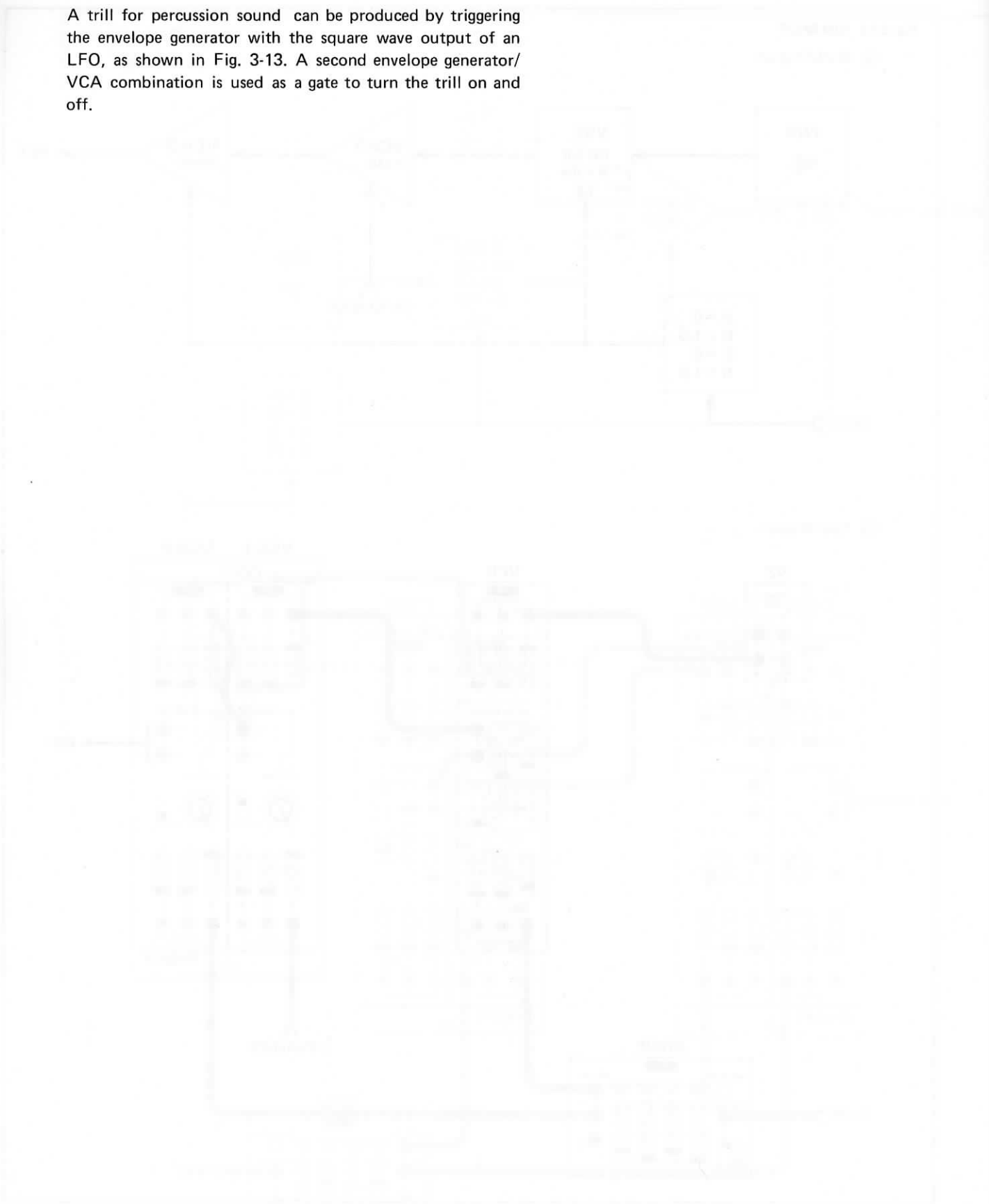
Fig. 3-13 Percussion Trill

ⓐ Block Diagram
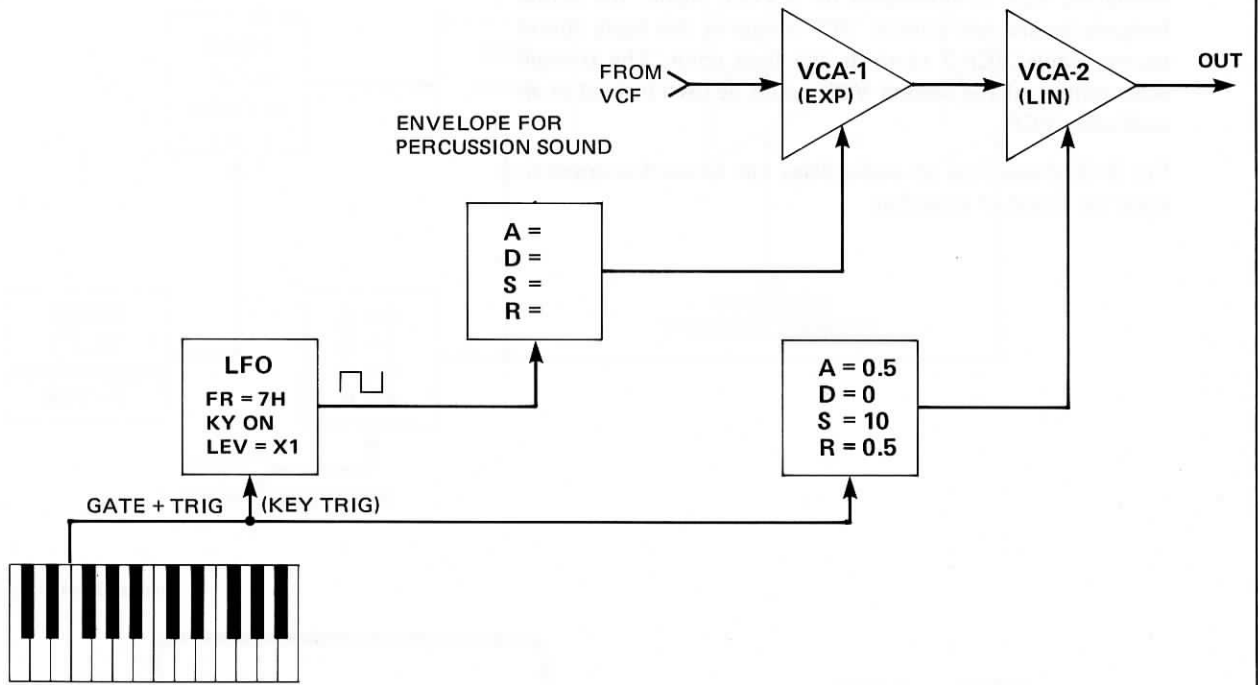
ⓑ Patch Diagram
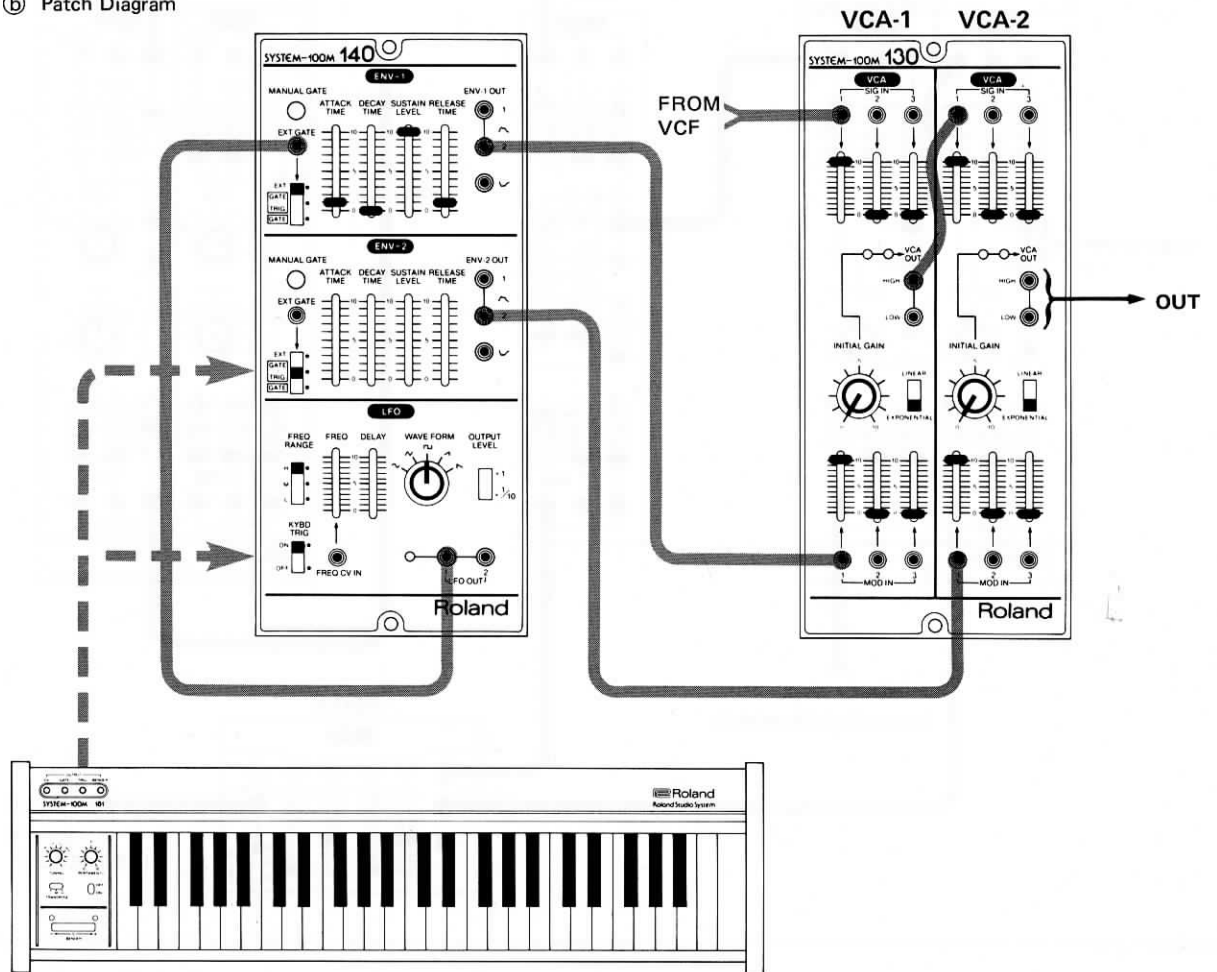
Fig. 3-14 shows a patch for a tom tom-like sound which uses a VCO modulated by a second VCO. The VCO frequencies are not critical. Fig. 3-15 shows a cow bell sound in which an oscillating VCF is modulated by a VCO. Again, the actual frequencies are not critical. VCF-1 acts as the basic sound source, while VCF-2 controls the tone color. The triangle wave output of the second VCO could be used instead of an oscillating VCF.

Fig. 3-16 shows how an audio delay can be used to approximate the sound of a cymbal.

Fig. 3-14 TOM TOM

(a) Block Diagram
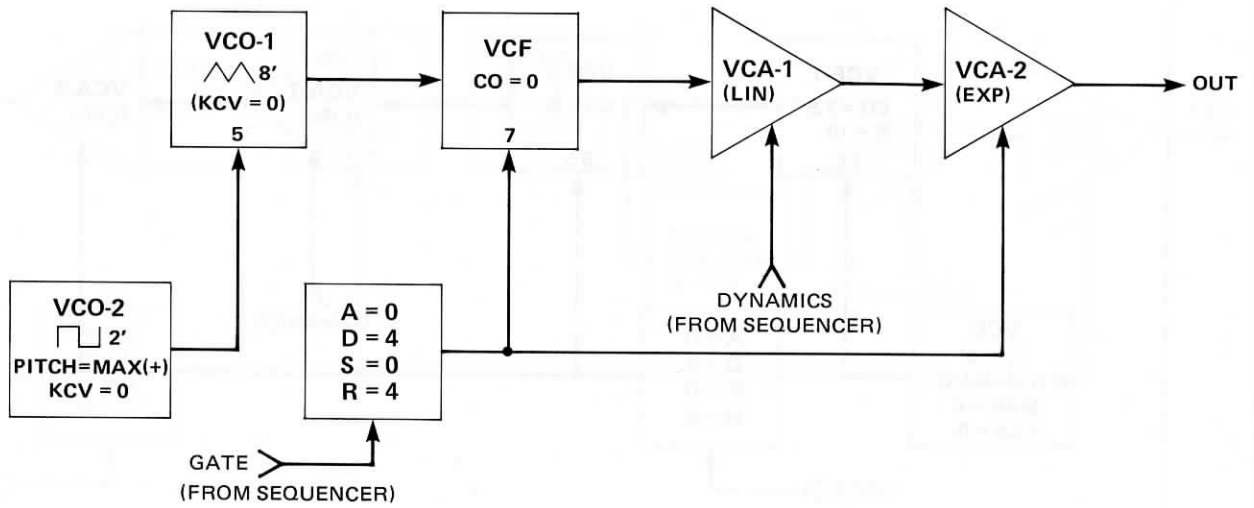
(b) Patch Diagram
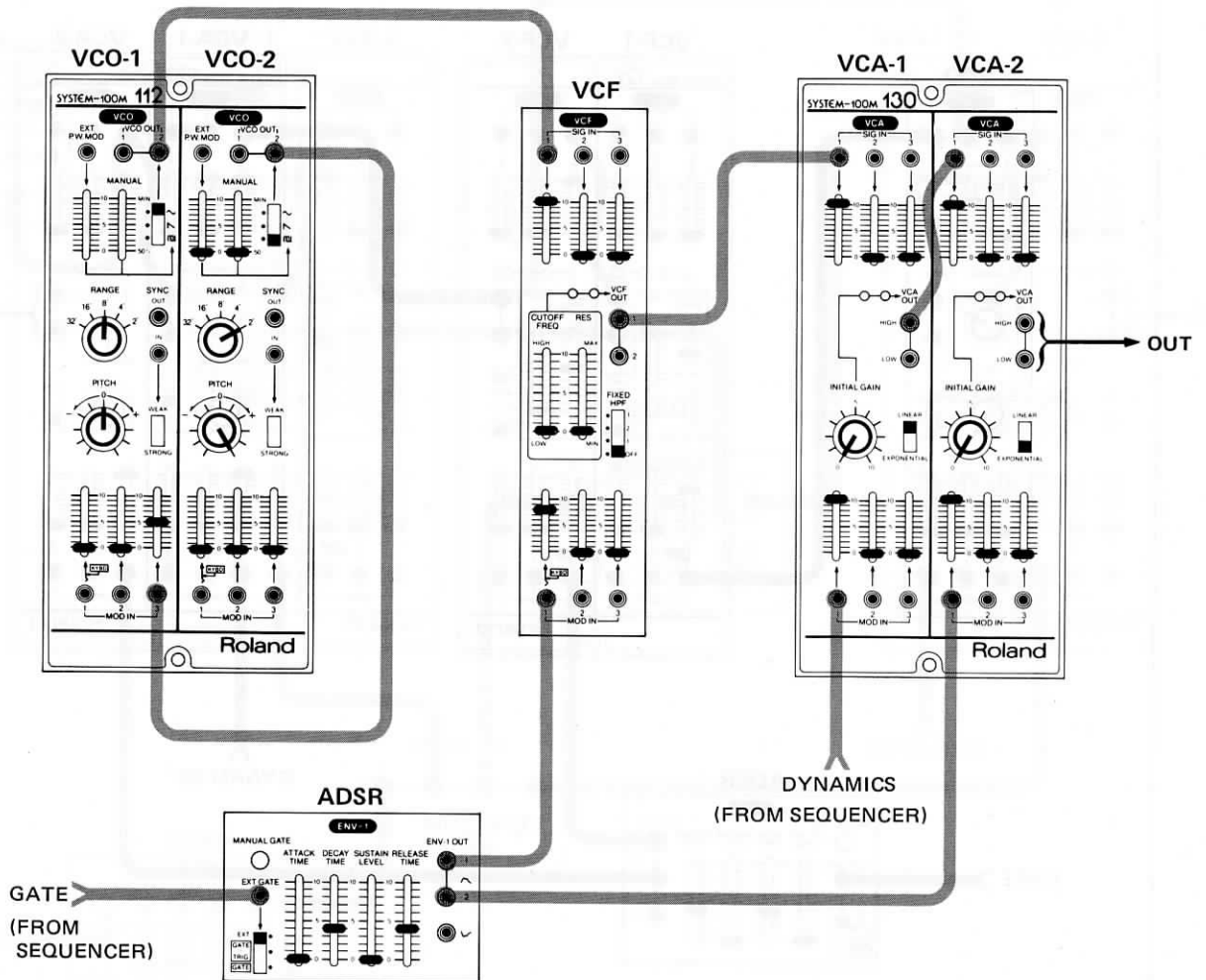
Fig. 3-15 COW BELL

ⓐ Block Diagram

VCF-1		VCF-2		VCA-1	VCA-2	
CO = 7.5		CO = 5		(LIN)	(EXP)	OUT
R = 10						
7.5		5.5				

VCO
⎍ 2'
PITCH=MAX(+)
MAN = 6
KCV = 0

A = 0
D = 4
S = 0
R = 4

DYNAMICS

GATE

ⓑ Patch Diagram

VCF-1   VCF-2   VCA-1   VCA-2

VCO

SYSTEM-100M **121**

SYSTEM-100M **130**

Roland   Roland

OUT

ADSR

DYNAMICS

GATE

Fig. 3-16 CYMBAL

ⓐ Block Diagram

```
┌──────────┐     ┌──────────┐     ┌──────────┐
│  WHITE   │     │  VCF-1   │     │  VCF-2   │
│          │ ──▶ │  CO = 10 │ ──▶ │  CO = 9  │
│  NOISE   │     │  R = 2   │     │  R = 10  │
│          │     │  HPF = 3 │     │  HPF = 3 │
└──────────┘     │   1.5    │     └──────────┘
                 └──────────┘
```

```
┌──────────┐
│  A = 0   │
│  D = 6   │
│  S = 0   │
│  R = 2   │
└──────────┘
```

GATE

AUDIO DELAY

MOD = 6
DEL = 3.5
R = 8.5

VCA (LIN)   VCA (EXP)   OUT

DYNAMICS

ⓑ Patch Diagram

WHITE NOISE

VCF-1   VCF-2

VCA-1   VCA-2

OUT

AUDIO DELAY

DYNAMICS

MULTIPLE JACK

a   b   c   d

MULTIPLE JACKS

ADSR

GATE
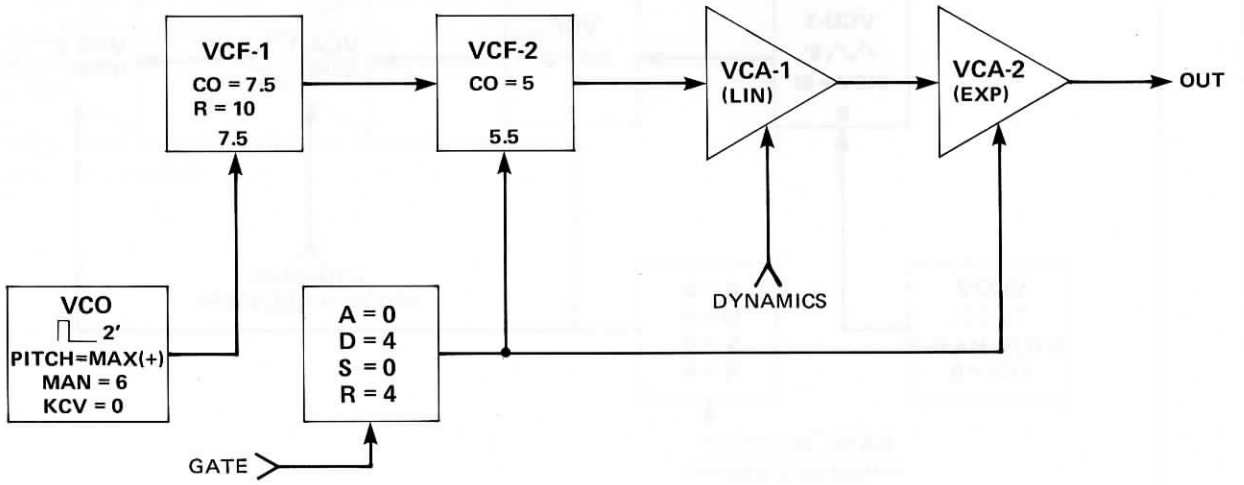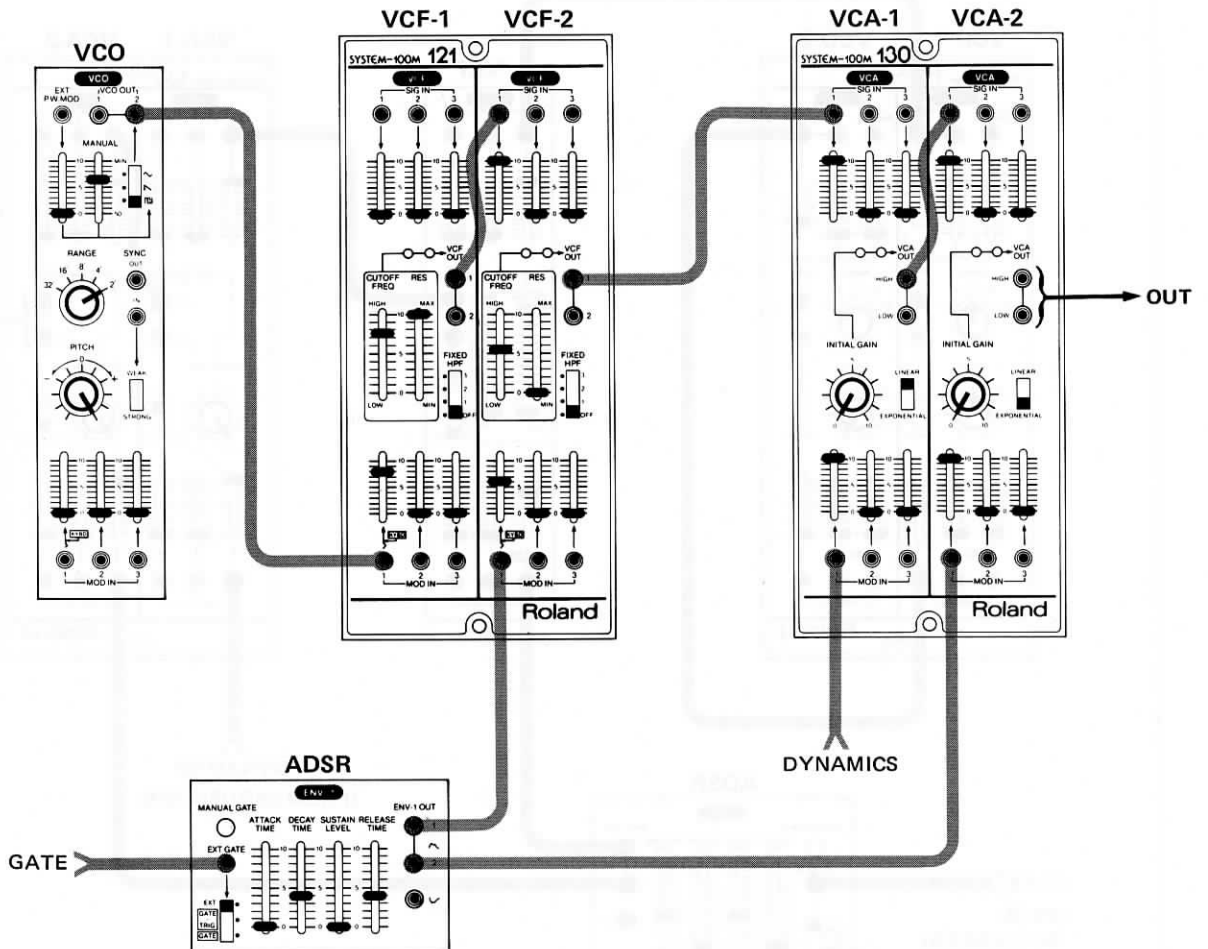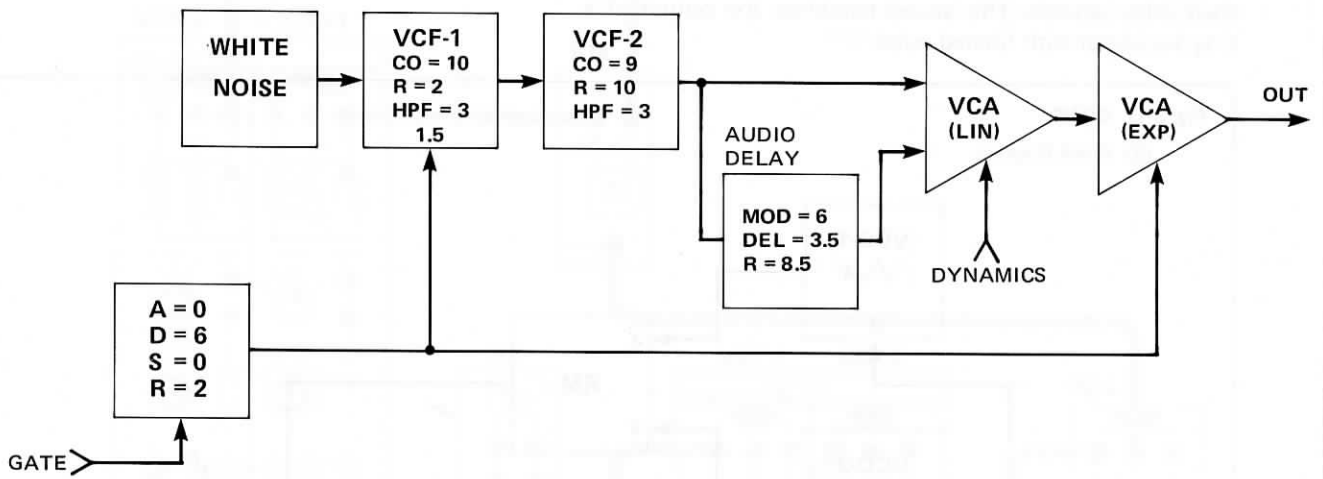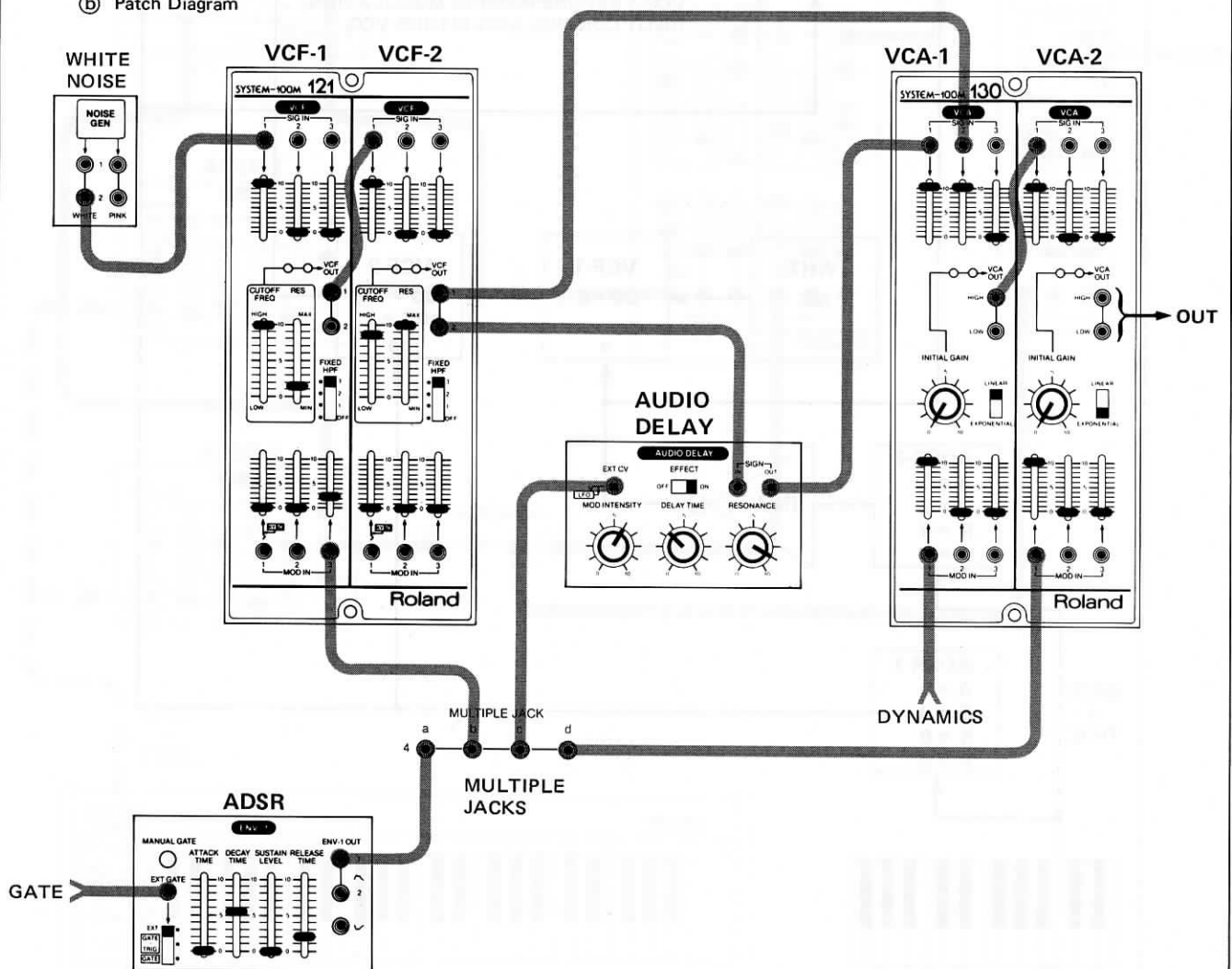
A more complex percussion sound is shown in Fig. 3-17. This type of sound would be better triggered from the keyboard controller rather than a sequencer because it is the type of sound which would be used more intermittently than other sounds. This sound combines the output of a ring modulator with filtered noise.

Fig. 3-17 GONG

ⓐ Block Diagram

TUNE TO PERFECT FIFTH ABOVE
VCO-1 BEFORE RAISING MODULATION
INPUT CONTROLS ON EITHER VCO.

VCO-1 ∧∧ 4′ 2

VCO-2 ∧∧ 4′ 2

RM
X
Y

VCA (EXP) 7 10 OUT

WHT NZ

VCF-1
CO = 8
4

VCF-2
CO = 1.5
HPF = 3
10

ADSR-2
A = 0
D = 2
S = 0
R = 0

INV

ADSR-1
A = 0
D = 8
S = 0
R = 8

GATE + TRIG

Fig. 3-17 (cont'd)

ⓑ Patch Diagram

NOTE: TUNE VCO-2 A PERFECT FIFTH ABOVE VCO-1 BEFORE RAISING MODULATION INPUT CONTROLS ON EITHER VCO.
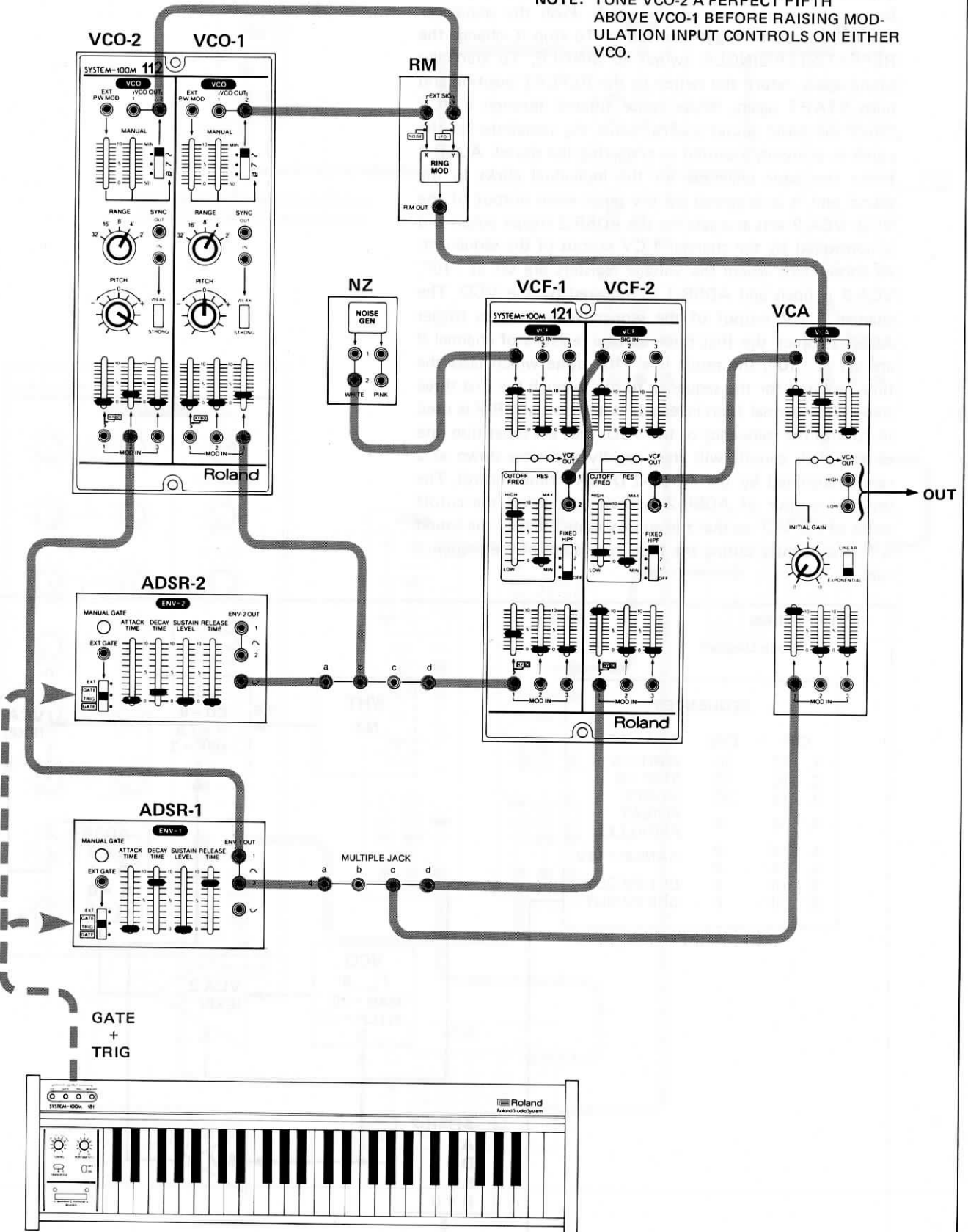
With all the sounds so far, it is possible to use the keyboard controller to play rhythmic patterns rather than the sequencer. With the guiro sound of Fig. 3-18, the sequencer forms an integral part of the patch. Push the sequencer START button to trigger the sound. To stop it, change the REPEAT/STEP/SINGLE switch to SINGLE. To start the sound again, return the switch to the REPEAT position and push START again. White noise filtered through a VCF forms the basic sound source, while the remainder of the patch is primarily devoted to triggering the sound. ADSR-1 forms the basic envelope for the individual clicks in the sound and it is triggered by the pulse wave output of the VCO. VCA-2 acts as a gate for the ADSR-2 trigger pulses and is controlled by the channel 1 CV output of the sequencer. At those steps where the voltage registers are set at "10", VCA-2 is open and ADSR-1 is triggered by the VCO. The channel 2 CV output of the sequencer is used to trigger ADSR-2. Since the first three voltage registers of channel 2 are set at "10", the result is a +10v pulse which lasts the time required for the sequence to run through the first three steps. The normal (non-inverted) output of ADSR-2 is use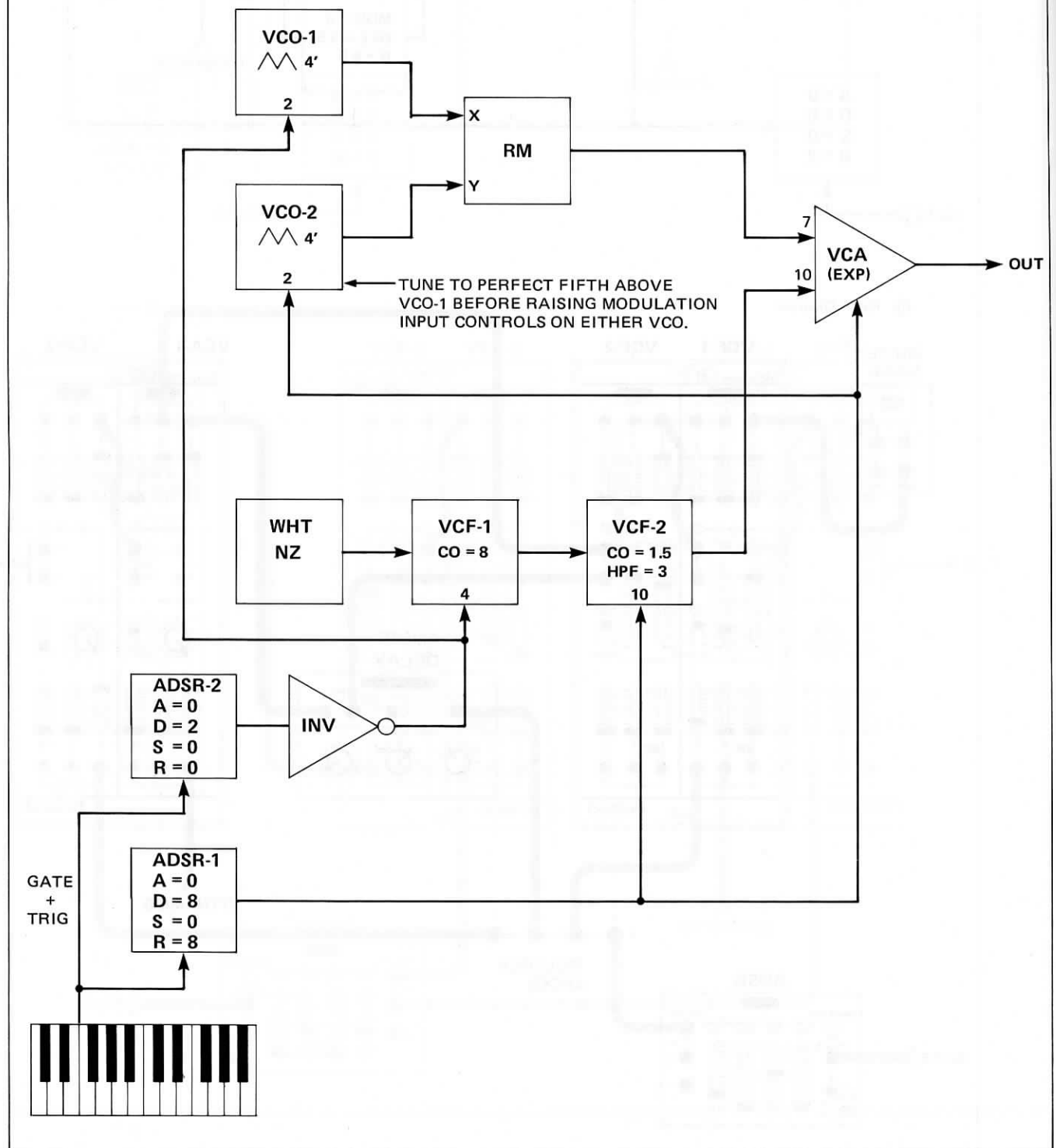d to control the frequency of the VCO, thus the repetition rate of the click sounds will start rapidly and slow down at a rate determined by the ADSR-2 DECAY time control. The inverted output of ADSR-2 is used to control the cutoff point of the VCF so that the approximate pitch of the sound will raise slightly during the first three steps of the sequence run.

Fig. 3-18 GUIRO

ⓐ Block Diagram

SEQUENCER		
CH1	CH2	TEM = 7.5
1. 10	10	PORT = 0
2. 10	10	STEP = 8
3. 10	10	MODES:
4. 0	0	PEPEAT
		PARALLEL
5. 10	0	RANGE = 10V
6. 0	0	
7. 10	0	CH1 CV OUT
8. 0	0	CH2 CV OUT

WHT NZ   7.5

VCF
CO = 8
R = 7.5
HPF = 3
1

VCA-1
(EXP)   OUT

ADSR-1
A = 0
D = 1
S = 0
R = 1

VCO
⊓_ 8'
MAN = 10
PITCH = −1
5

VCA-2
(EXP)

ADSR-2
A = 0
D = 2
S = 0
R = 0

INV
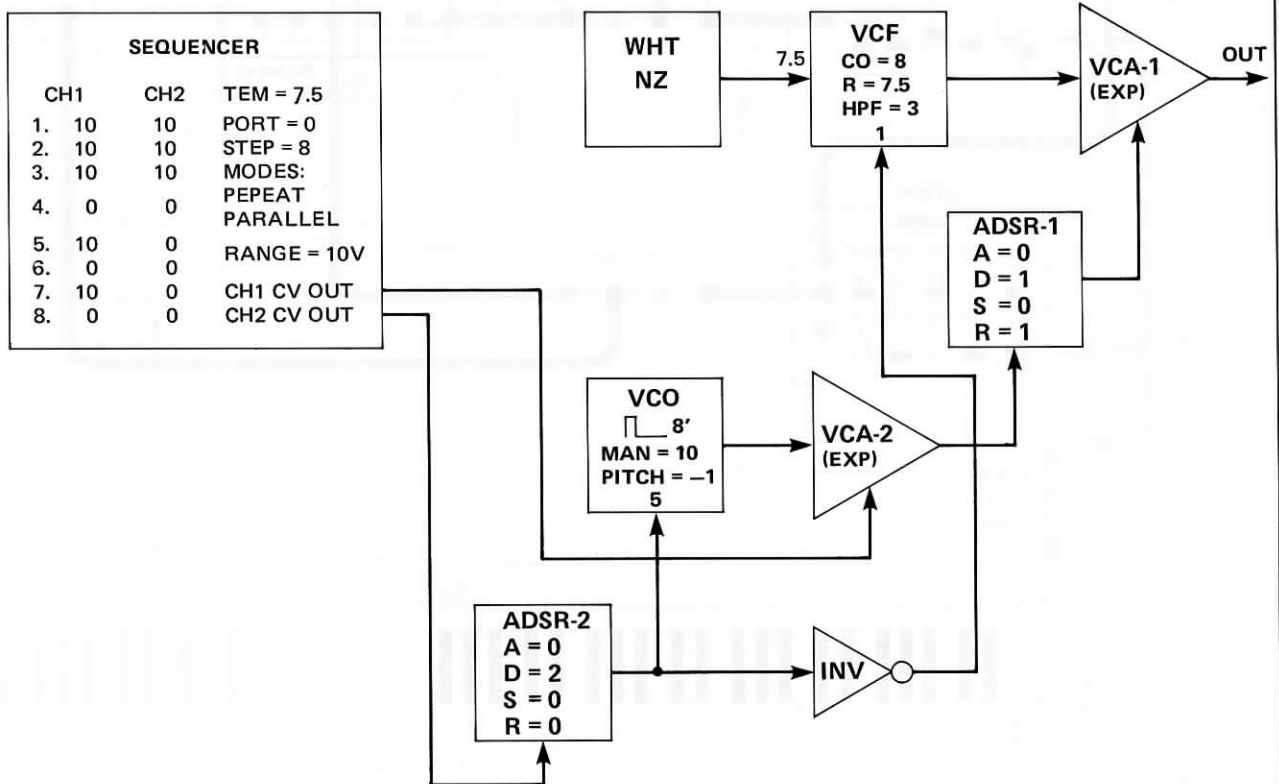
Fig. 3-18 (cont'd)

ⓑ Patch Diagram

SEE TEXT FOR INSTRUCTIONS
ON TRIGGERING THIS SOUND.

OUT

SYSTEM-100M **182**

SEQUENCER

Roland

As an experiment, try
setting CH2 Step 2 at "0"
and Step 7 at "10".
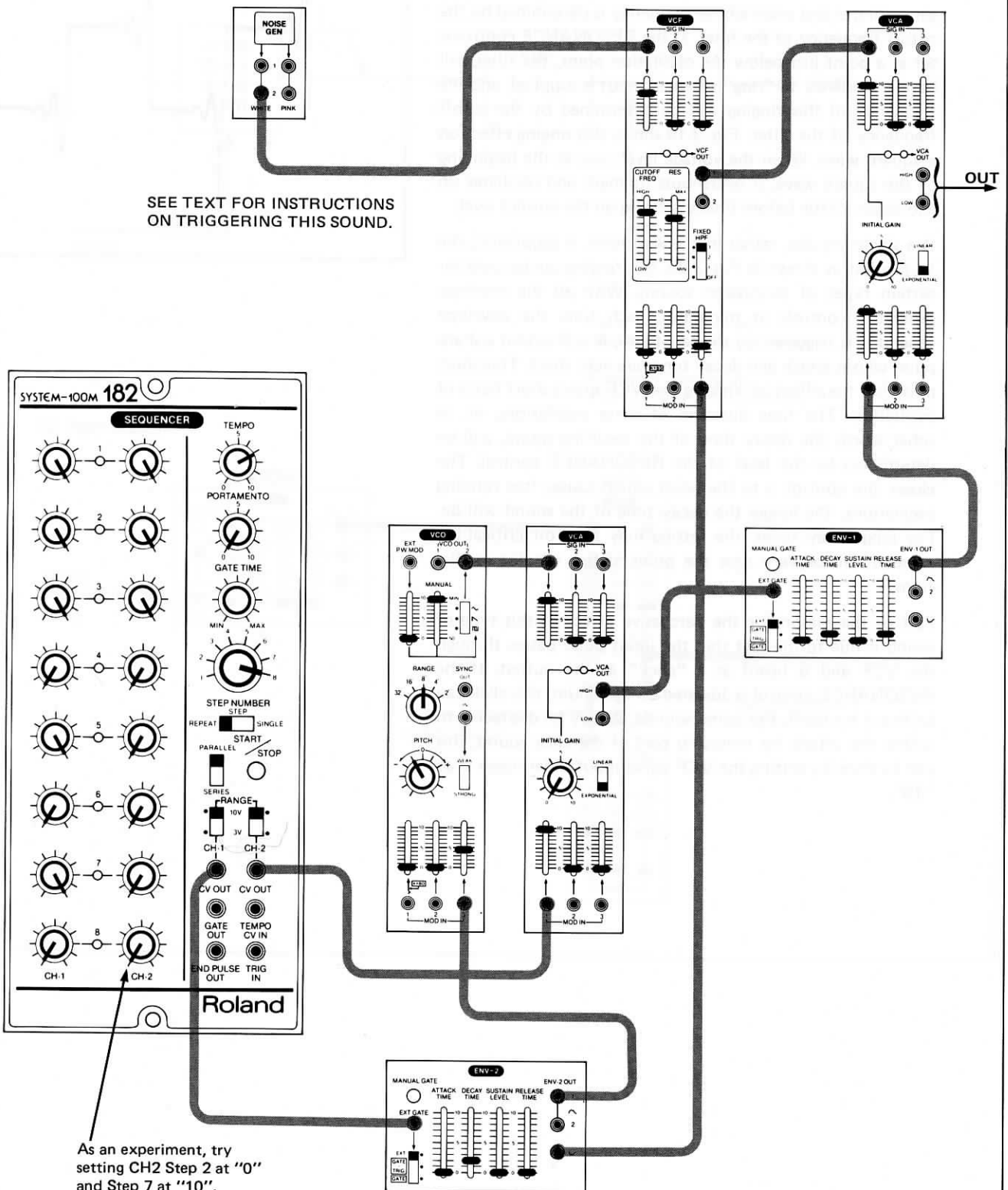
3-4   VCF Ringing as a Sound Source*

It has already been demonstrated that if the VCF RESO-NANCE control is raised to maximum, the VCF will oscillate, generating a sine wave whose frequency is determined by the cutoff frequency of the filter. If the RESONANCE control is set at a point just below the oscillation point, the filter will have a tendency to "ring" when an input is supplied, and the frequency of this ringing will be determined by the cutoff frequency of the filter. Fig. 3-19 shows this ringing effect on a square wave. When the voltage level rises at the beginning of the square wave, it overshoots its mark and oscillates up and down a little before finally settling on the correct level.

If a single impulse, rather than a waveform, is supplied to the VCF input as shown in Fig. 3-20, this ringing can be used for certain types of percussion sounds. With all the envelope generator controls at minimum, each time the envelope generator is triggered by the gate pulse, it will output a sharp pulse whose attack and decay times are very short. This short pulse has the effect of kicking the VCF into a short burst of oscillation. The time duration of these oscillations, or, in other words the decay time of the resulting sound, will be determined by the level of the RESONANCE control. The closer the control is to the point which causes free running oscillations, the longer the decay time of the sound will be. For long decay times, the setting may be a bit critical because it will be very near the point of free running oscillations.

Part of the reason for the percussive effect of this type of sound is due to the fact that the input pulse passes through the VCF and is heard as a "click" at the output. If the RESONANCE control is lowered to minimum, this click can be heard by itself. For some sounds, it may be desireable to soften the attack by removing part of the click sound; this can be done by setting the VCF signal input slider lower than "10".

Fig. 3-19 Effect of VCF resonance on square wave

RINGING

---
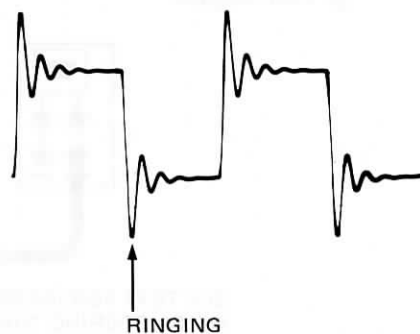
* The last half of Chapter 5 (starting with Section 5-8, p. 58) in *A Foundation for Electronic Music* contains a great deal of background information which will give a clearer understanding of the material contained in this section.

Fig. 3-20 VCF Ringing for Percussion Voices

ⓐ Block Diagram
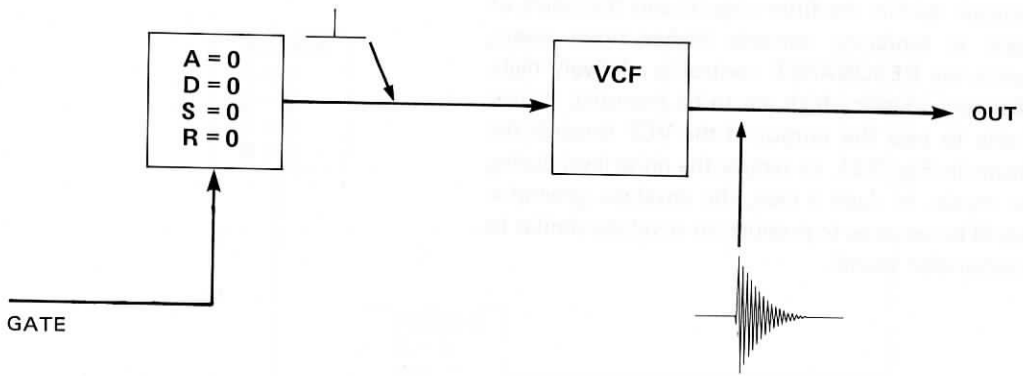
Decay time depends on
RESONANCE control setting.

Frequency depends on
VCF CUTOFF FREQ setting.

ⓑ Patch Diagram

ADSR

VCF

GATE

GATE

OUT

DETERMINES
FREQUENCY

DETERMINES
DECAY TIME
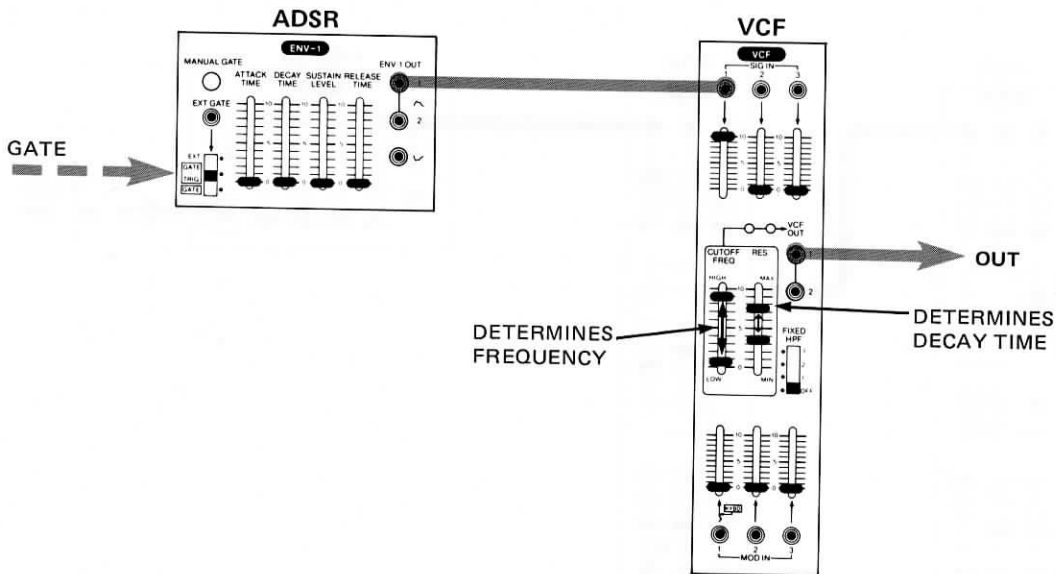
Note that this form of sound generation does not require a VCA since the natural decay of the oscillations forms its own envelope. The resonance effect is produced by means of positive feedback within the filter circuits and the result of this feedback is tendancy towards higher noise levels, especially when the RESONANCE control is relatively high. When synthesizing sounds which are to be recorded, it may prove desirable to pass the output of the VCF through the VCA, as shown in Fig. 3-21, to reduce the noise level during rests in the music. In such a case, the envelope generator controls should be set so as to produce an envelope similar to that of the percussion sound.

Fig. 3-21 Using a VCA with VCF Ringing

ⓐ Block Diagram

ⓑ Patch Diagram

Fig. 3-22 shows a bongo-like sound which uses a VCO to modulate the VCF in order to produce a waveform more complex than a sine wave.

Fig. 3-22 BONGO DRUMS

ⓐ Block Diagram

ADSR-1
A = 0
D = 0
S = 0
R = 0

VCO
/\/ 2'
PITCH = + MAX
5

VCF
CO = 3
R = 6
10   2   1.5

→ OUT

KEY CV

ADSR-2
A = 0
D = 1.2
S = 0
R = 1.2

GATE + TRIG

ⓑ Patch Diagram

VCO

ADSR-1

VCF

→ **OUT**

ADSR-2

KEY CV

GATE + TRIG

KEY CV
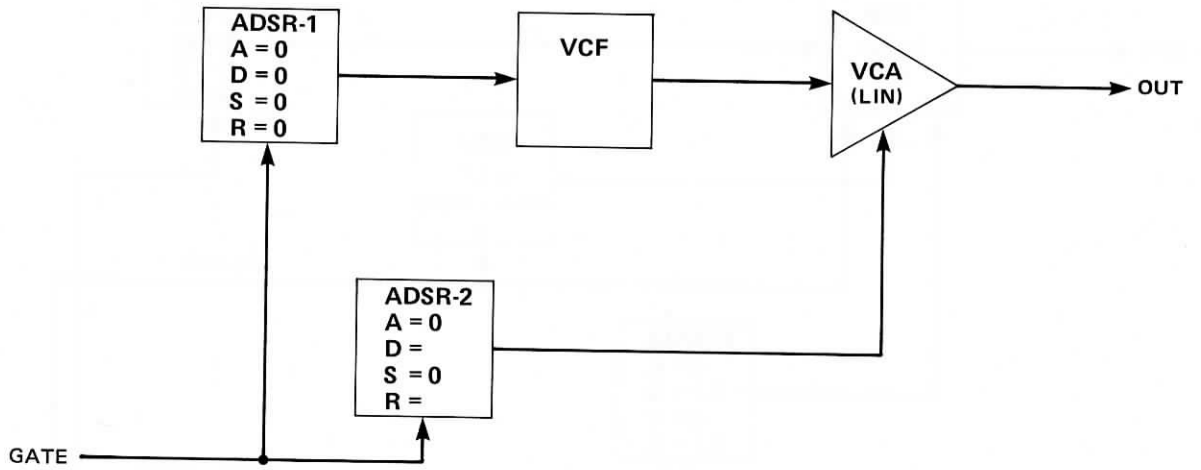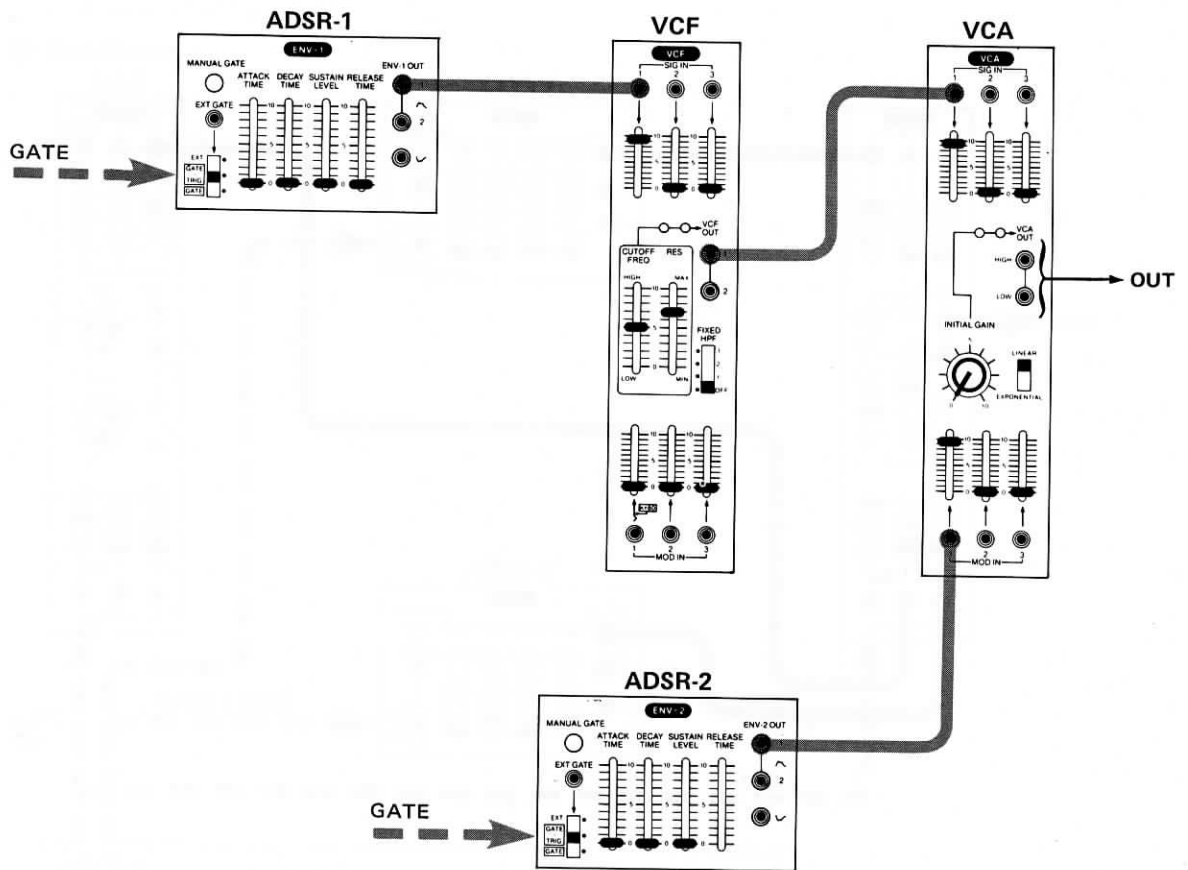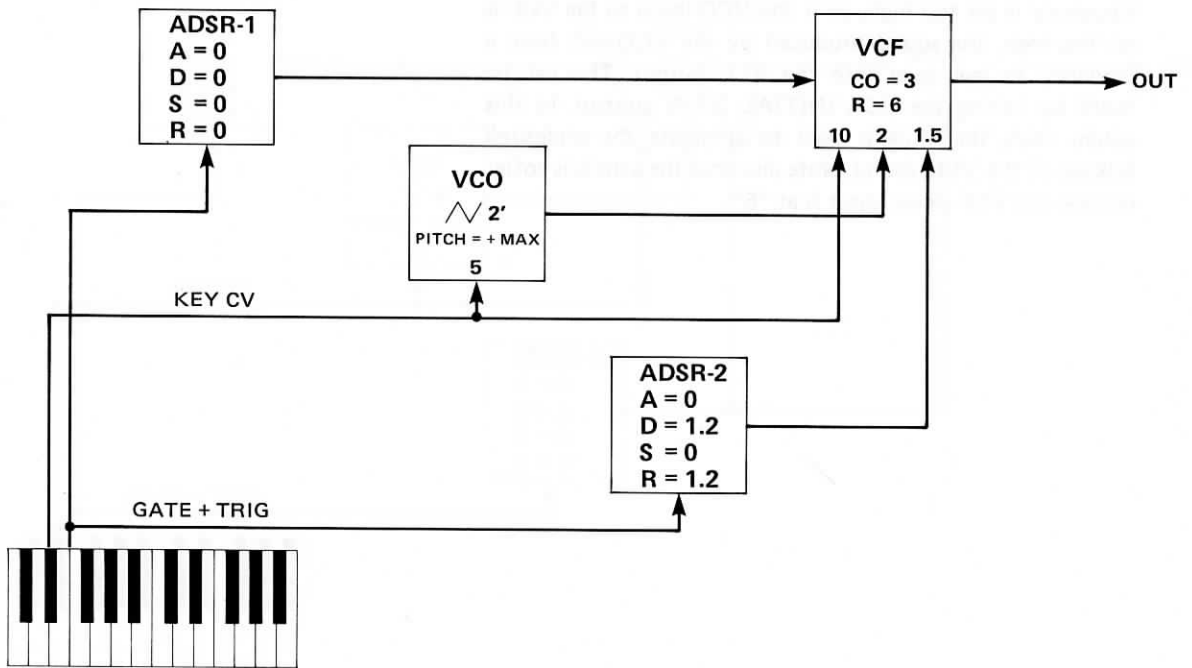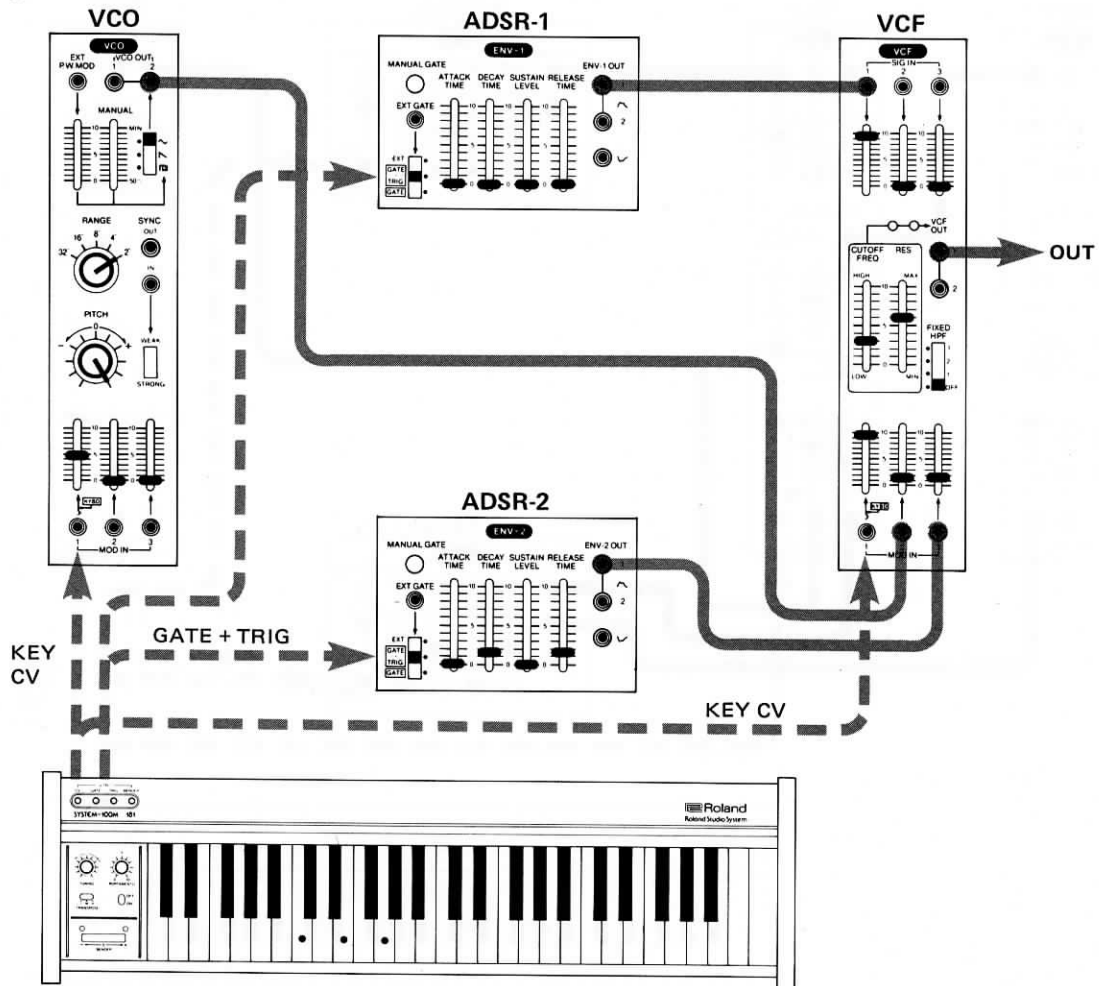
Try these three keys for a three-drum set

Fig. 3-23 a similar patch for generating sounds like those of tuned steel oil drums. This oil drum patch demonstrates a point where a bit of caution is needed. If the VCF cutoff frequency is set too high, or if the VCO input to the VCF is set too high, the sound produced by the VCO will have a tendancy to leak over into the VCF output. This can be heard by raising the VCA INITIAL GAIN control. In this patch, then, the VCA is used to eliminate the undesired leaking of the VCO sound. Note also that the attack is softer because the VCF signal input is at "6".

Fig. 3-23 STEEL OIL DRUMS

ⓐ Block Diagram
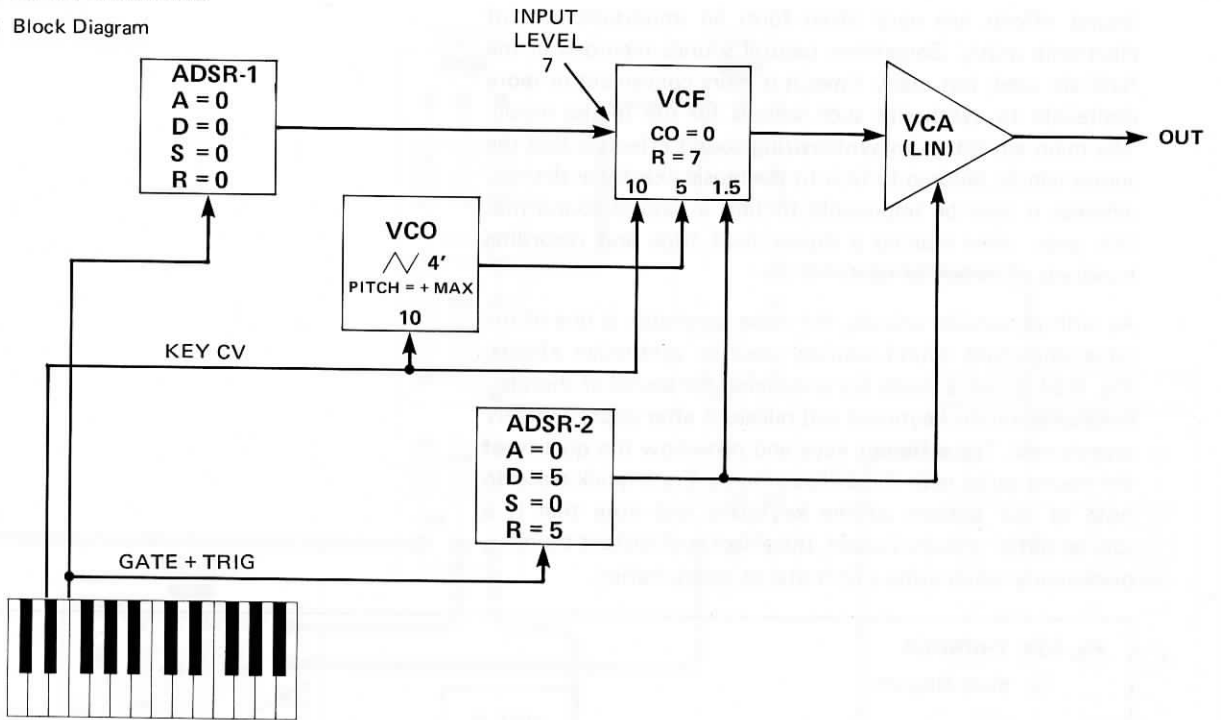
ⓑ Patch Diagram

3-5   Effect Sounds

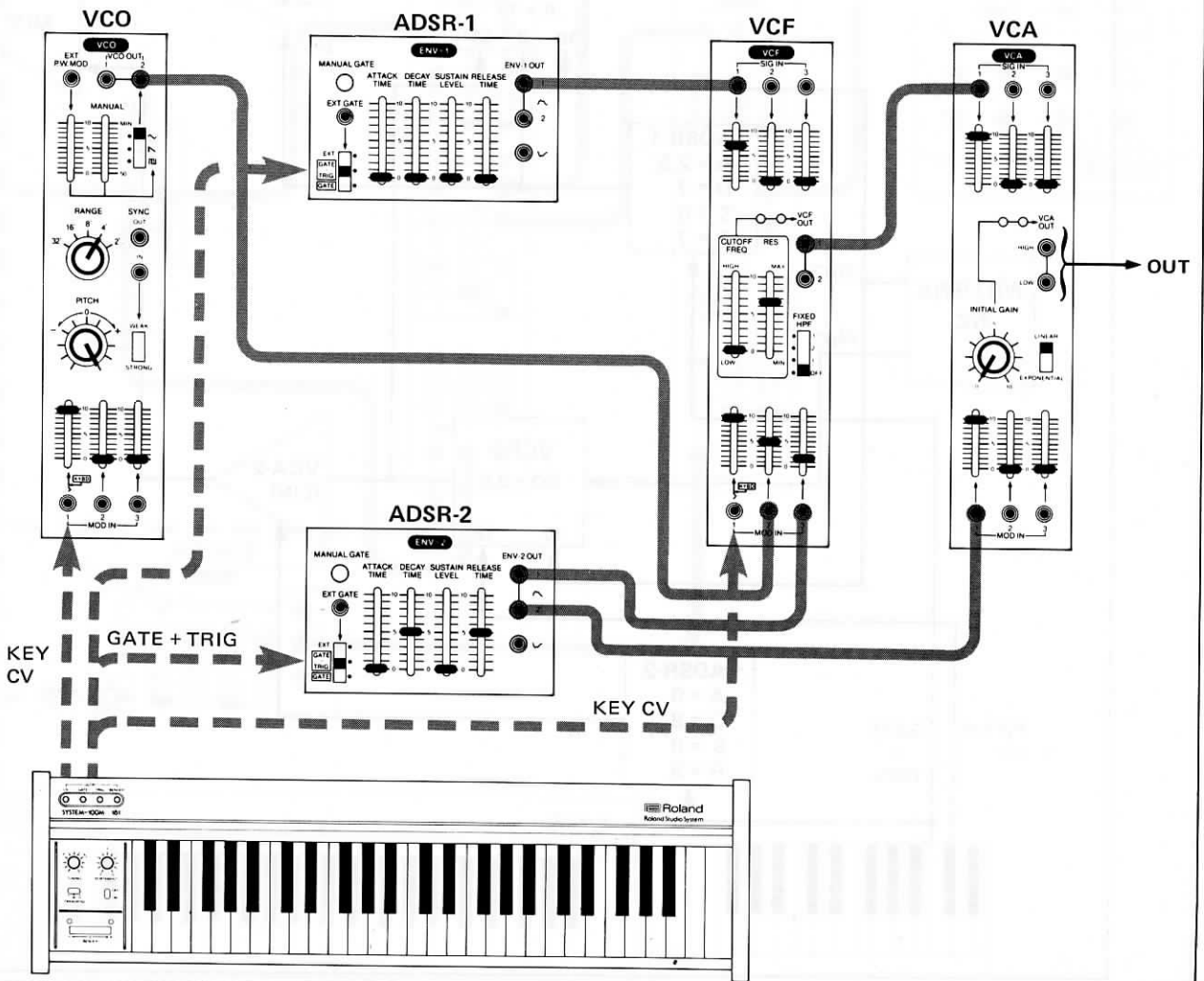Sound effects can very often form an important part of electronic music. Sometimes natural sounds recorded in the field are used, but many times it is more convenient or more desireable to synthesize such sounds for use in the music. The main advantage to synthesizing sound effects is that the sound can be tailored to fit into the music exactly as desired, whereas it may be impossible to find a natural sound that fits, even after making a dozen field trips and recording hundreds of meters of tape.

As with percussion sounds, the noise generator is one of the most important sound sources used to synthesize effects. Fig. 3-24 shows a patch for producing the sound of thunder. Press a key on the keyboard and release it after approximately one second. Try different keys and note how the quality of the sound varies with the different keys. Try a quick staccato note at the bottom of the keyboard and note that if a low amplifier volume is used, the effect is of distant thunder, particularly when using a little stereo reverberation.

Fig. 3-24 THUNDER

(a) Block Diagram
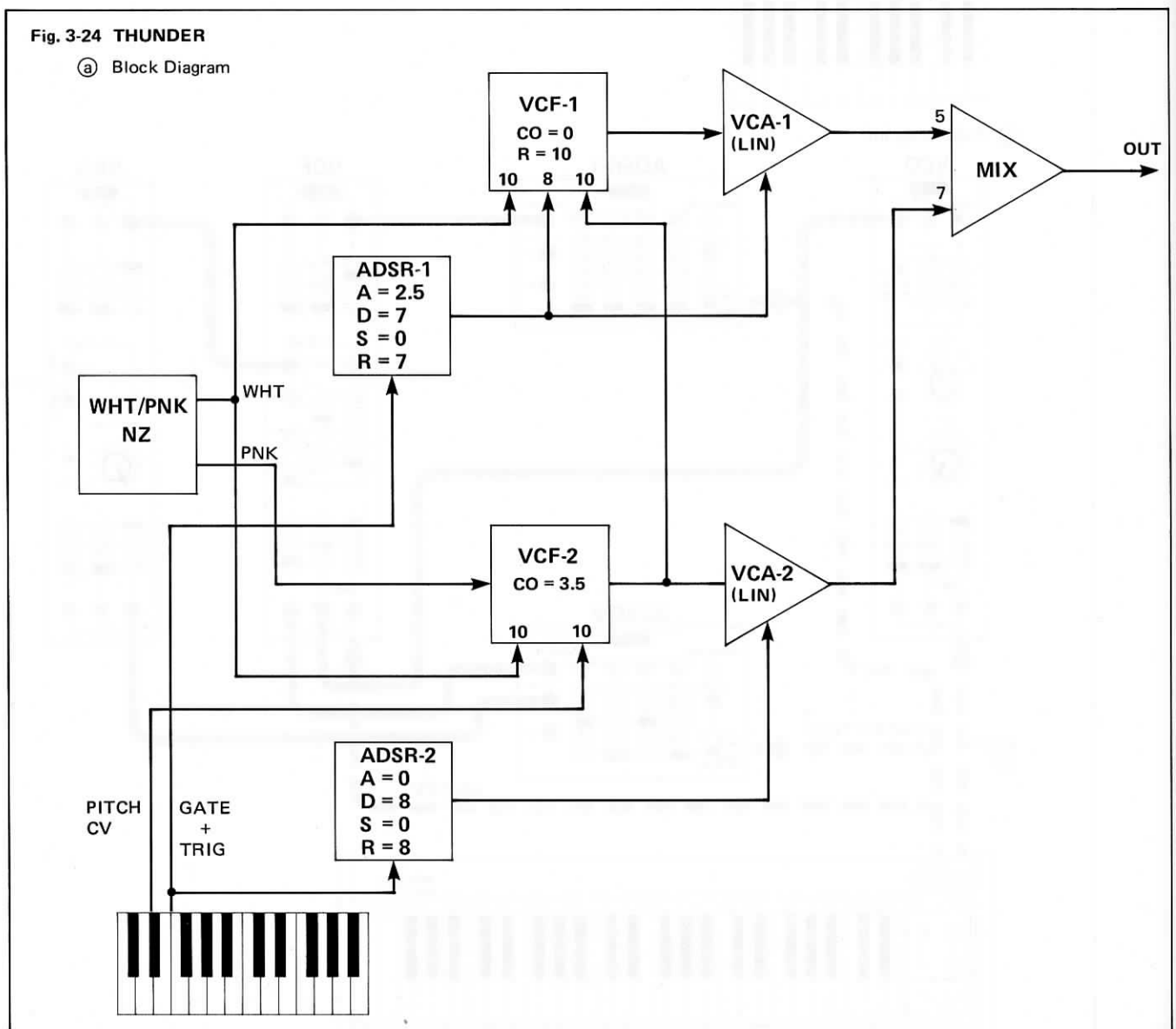
Fig. 3-24 (cont'd)

ⓑ Patch Diagram
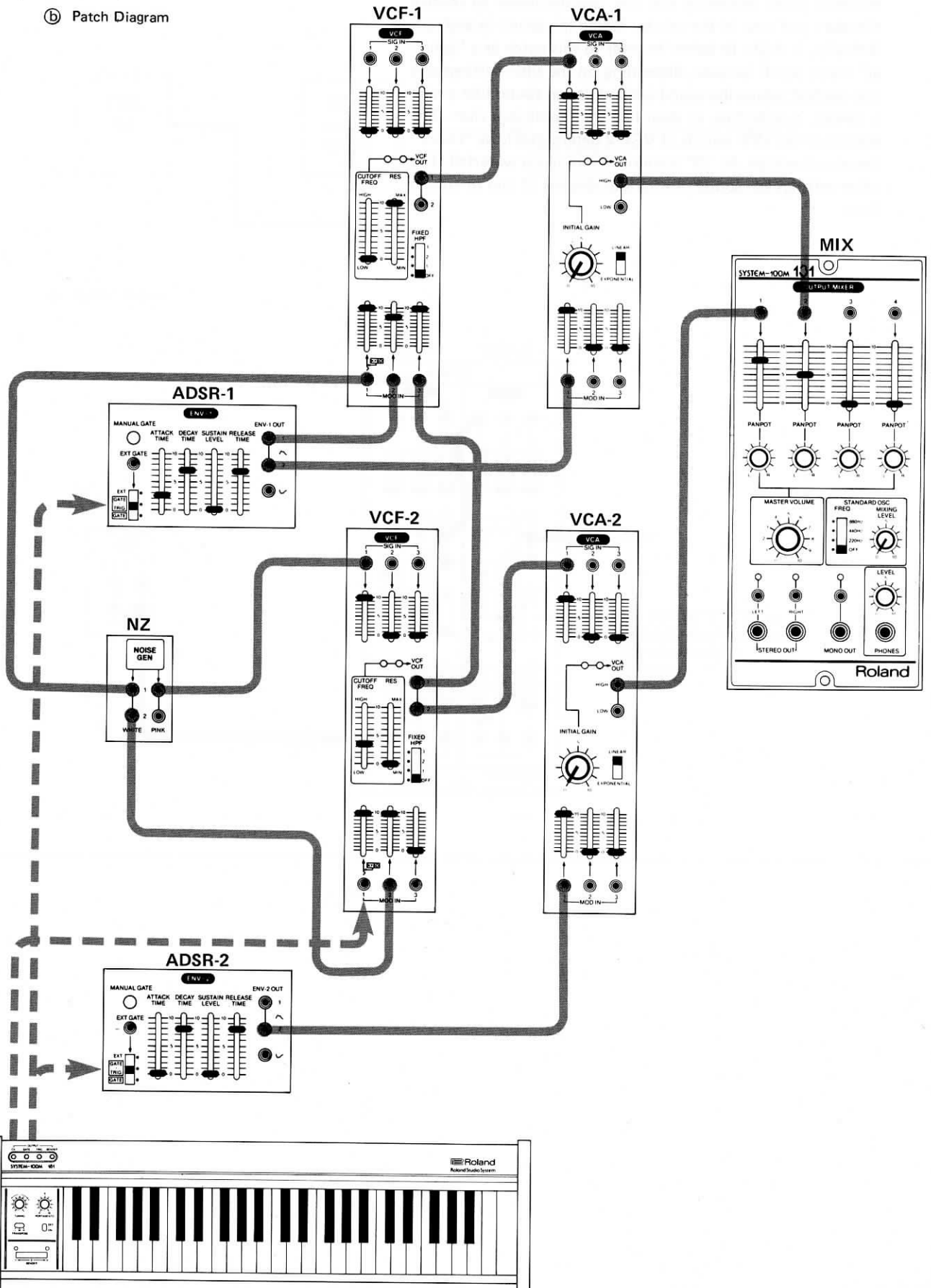
Fig. 3-25 shows a patch for creating rain to go along with the thunder. When recording the rain, use the mixer to control the start and stop of the rain by fading the sound in and out. Actually, it might be better to refer to this patch as a "general" water patch because, depending on the filter settings and the context where the sound is heard, it can sound like a rain, a stream, a waterfall, or even like the rapids in a river. The setting of the HPF switch of VCF-2 determines how "heavy" the sound will be. At "0" it sounds more like a waterfall. The other settings can sound like various degrees of rain or stream flow.

Fig. 3-25 RAIN

ⓐ Block Diagram

```
┌──────┐        ┌──────────┐      ┌──────────────┐
│ PNK  │        │  VCF-1   │      │   VCF-2      │
│ NZ   │────────│  CO = 8  │─────▶│   CO = 8     │────▶ OUT
│      │    │   │  R = 10  │      │ HPF = 2 OR 3 │
└──────┘    │   │   10     │      └──────────────┘
            │   └─────▲────┘
            │         │
            └─────────┘
```

ⓑ Patch Diagram

Set HPF at "1", "2", or "3", depending on how heavy the rain should be. (See text).
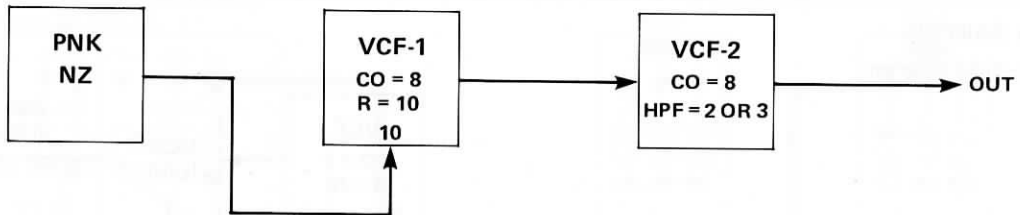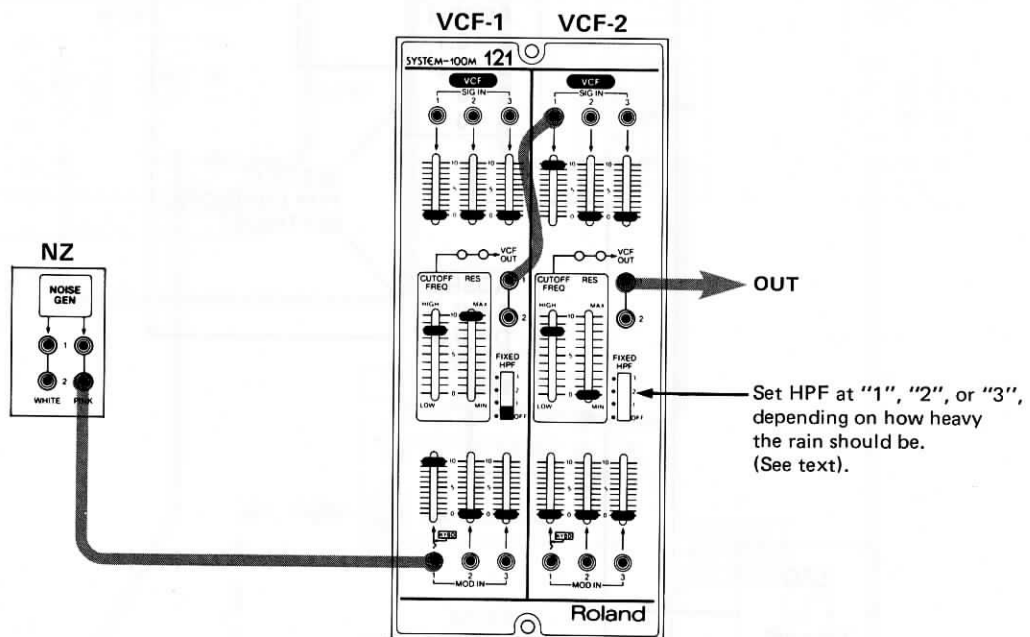
Fig. 3-26 shows a patch for producing the sound of dripping water for after the rain. If a high level of reverberation is used, it will produce the feeling of being in a cave with water dripping from the ceiling into a pool.

Fig. 3-26 DRIPPING

ⓐ Block Diagram

VCF
CO = 7
R = 10
5   1.5

VCA
(LIN)

OUT
(USE REVERBERATION)

ADSR-1
A = 0.1
D = 0.3
S = 0
R = 0

SEE TEXT
FOR ENVELOPE
SETTINGS

ADSR-2
A = 0
D = 0.3
S = 0
R = 0

LFO
FR = 5M
LEV = X1

FREQ
CV IN

WHT
NZ

S/H
LAG = 0

EXT
CLK IN

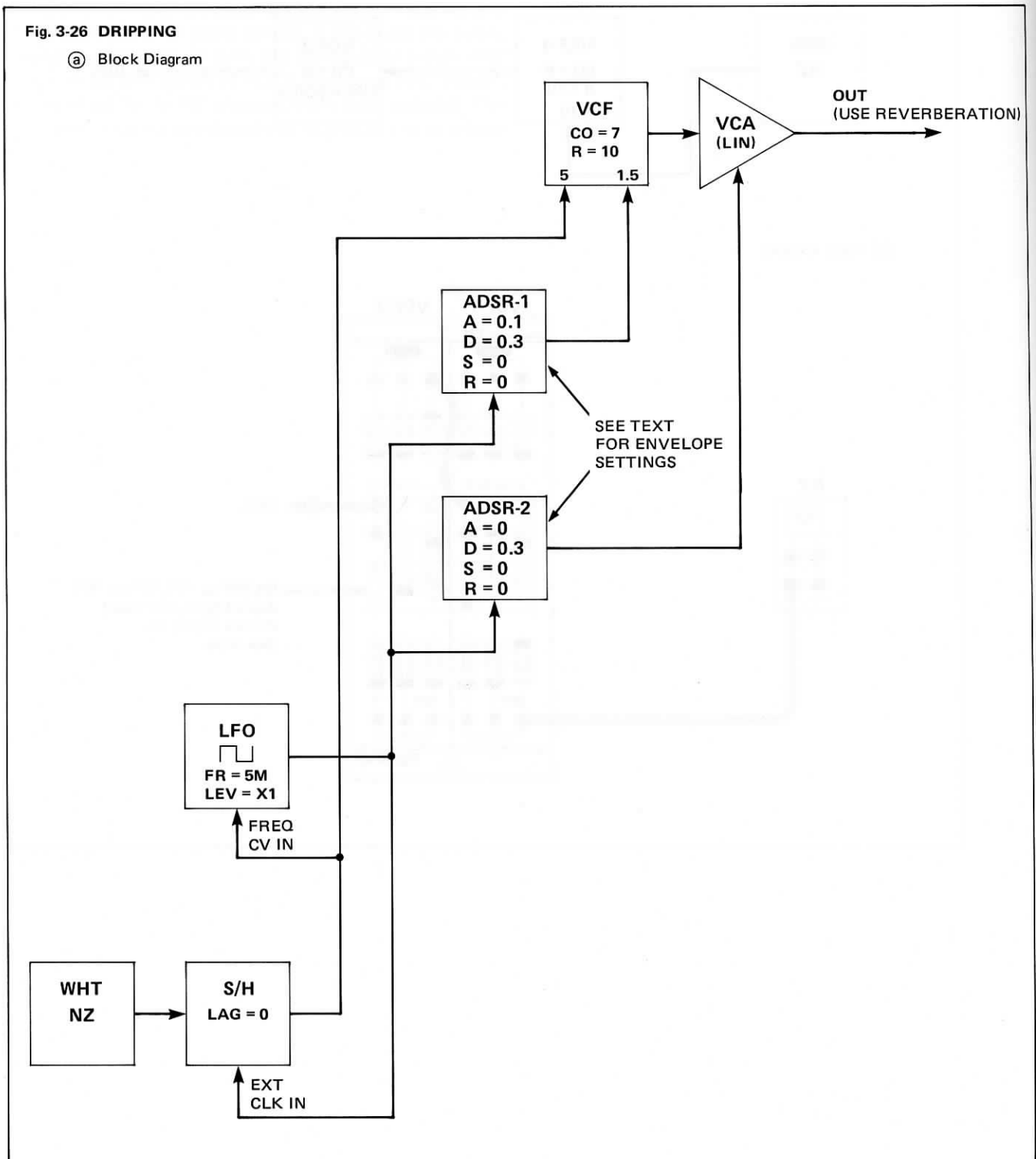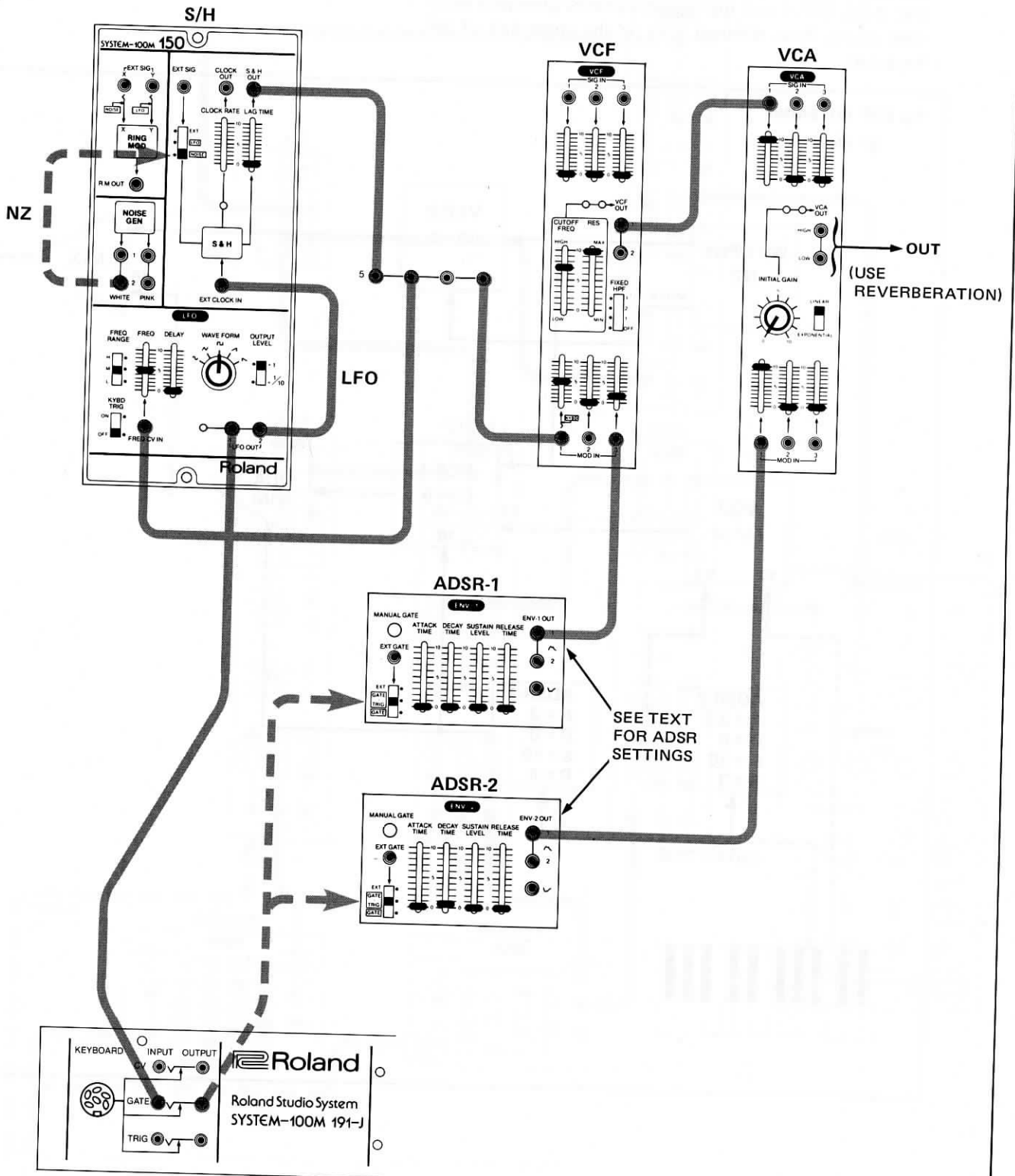Fig. 3-26 (cont'd)

In Fig. 3-27 is shown a standing ovation which might be added to the end of a recorded composition. VCF-2 produces the applause sound and is very similar to the rain patch of Fig. 3-25, VCF-1 and the related elements generate a whistling sound. Press different keys on the upper half of the keyboard.
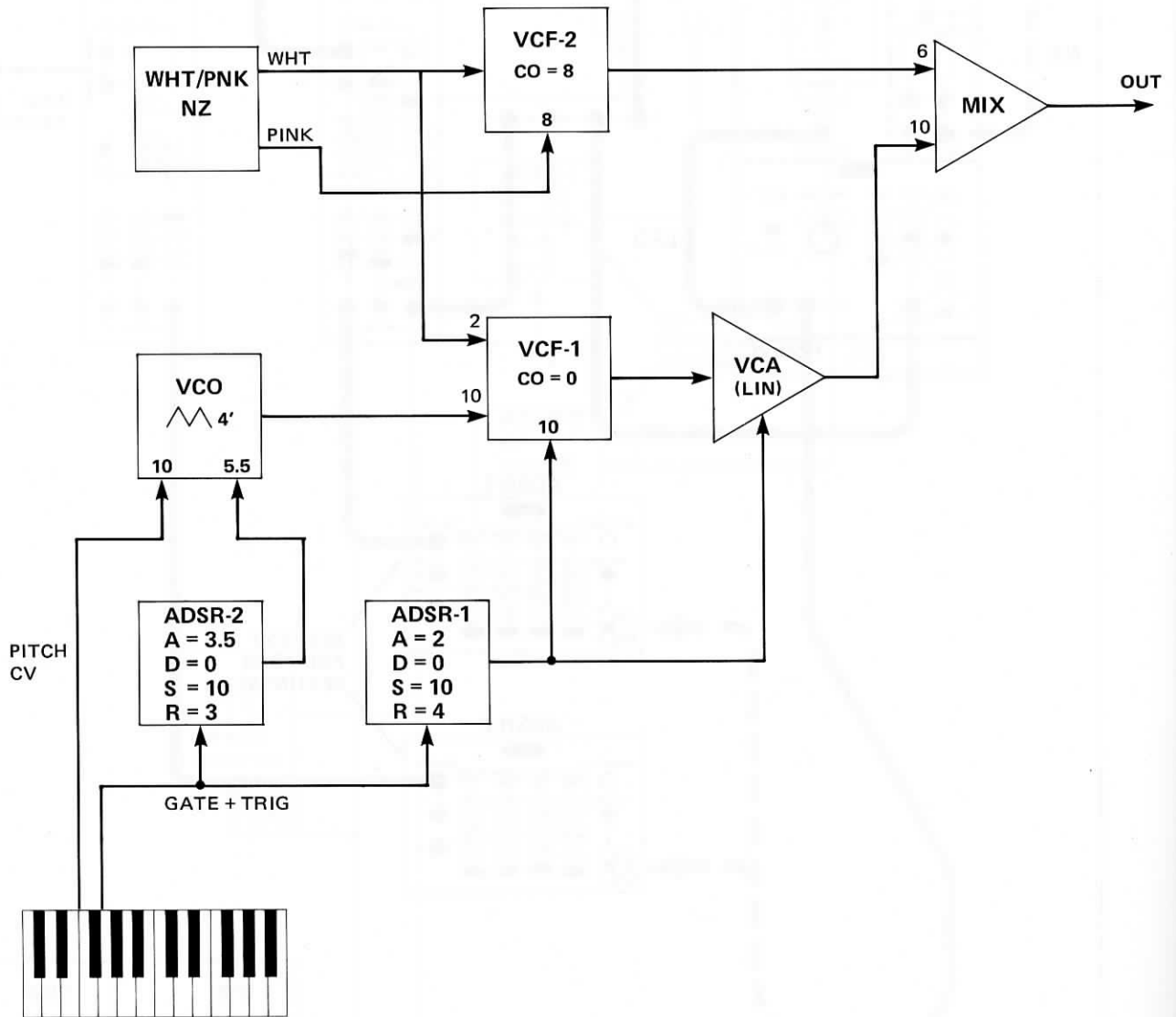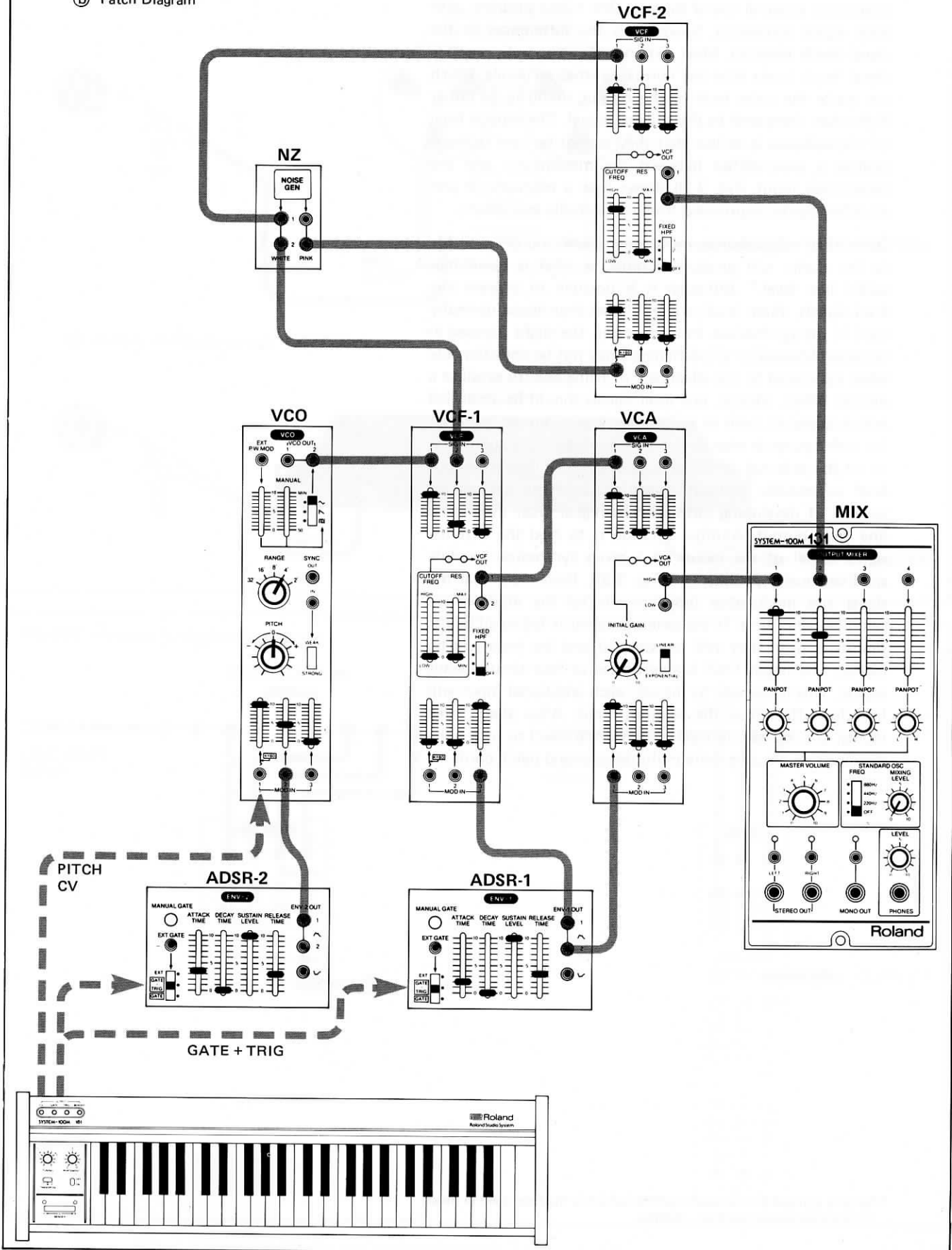
Fig. 3-27 CHEERING

ⓐ Block Diagram

Fig. 3-27 (cont'd)

ⓑ Patch Diagram
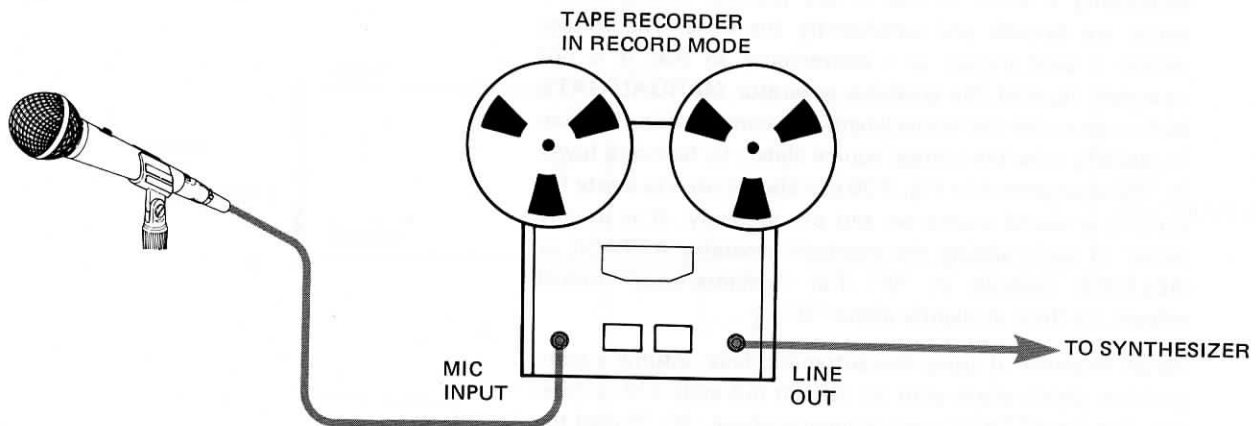
3-6 **Processing External Signal Sources**

The voltage controlled synthesizer makes an ideal device for processing external sound sources. One minor problem with such signal processing, however, is the differences in the signal levels involved. Most external sound sources produce signal levels lower than the normal synthesizer levels, which can cause the noise level of the output sound to be rather high when compared to the original signal. The output level of microphones is so low that they cannot be used without placing a preamplifier between the microphone and the synthesizer input. Fig. 3-28 shows how a microphone preamplifier can be improvised from other studio equipment.

Other than microphones, most other sound sources available in the studio will produce outputs at what is sometimes called **line level.** * Although it is possible to process line level signals, these levels are still lower than those normally used in the synthesizer. In many cases, the slight increase in noise level caused by this difference may not be objectionable when compared to the advantage of being able to produce a desired effect. Ideally, line level signals should be amplified before applying them to synthesizer inputs, but an amplifier for such a purpose may not be easy to obtain. One solution is to set the external device so as to produce as high an output level as possible without distortion, as many devices are capable of developing output levels higher than their rated line level output. Another solution is to feed the external signal to all of the inputs of a given synthesizer module simultaneously, as shown in Fig. 3-29. Remember that the signal and modulation input mixers for the modules are summing amplifiers. If the external signal is fed to all inputs simultaneously, they will be summed and the level will be higher. The upper limit is about three or four simultaneous inputs. This is because to the ear, each additional input will have less effect than the previous input. After about three inputs, the increase in level becomes too small to offset the disadvantage of using more multiple jacks and patch cords.
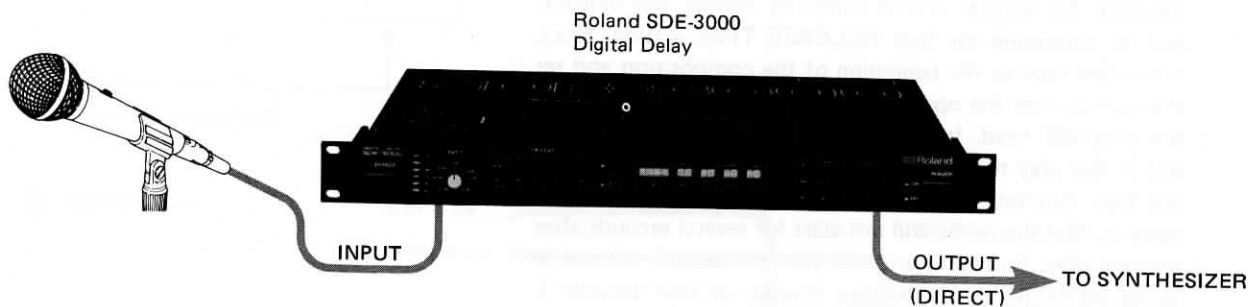
* Usually somewhere between +4dBm (which is the level used in most professional equipment) to −10dBm.

Fig. 3-28 Improvising a Microphone Preamplifier

(a) Using a tape recorder

TAPE RECORDER
IN RECORD MODE

MIC
INPUT

LINE
OUT

TO SYNTHESIZER

(b) Using an effects device with microphone input

Roland SDE-3000
Digital Delay

INPUT

OUTPUT
(DIRECT)

TO SYNTHESIZER

Fig. 3-29 Increasing Synthesizer Input Levels

MULTIPLE JACK

LINE LEVEL
INPUT

OUTPUT

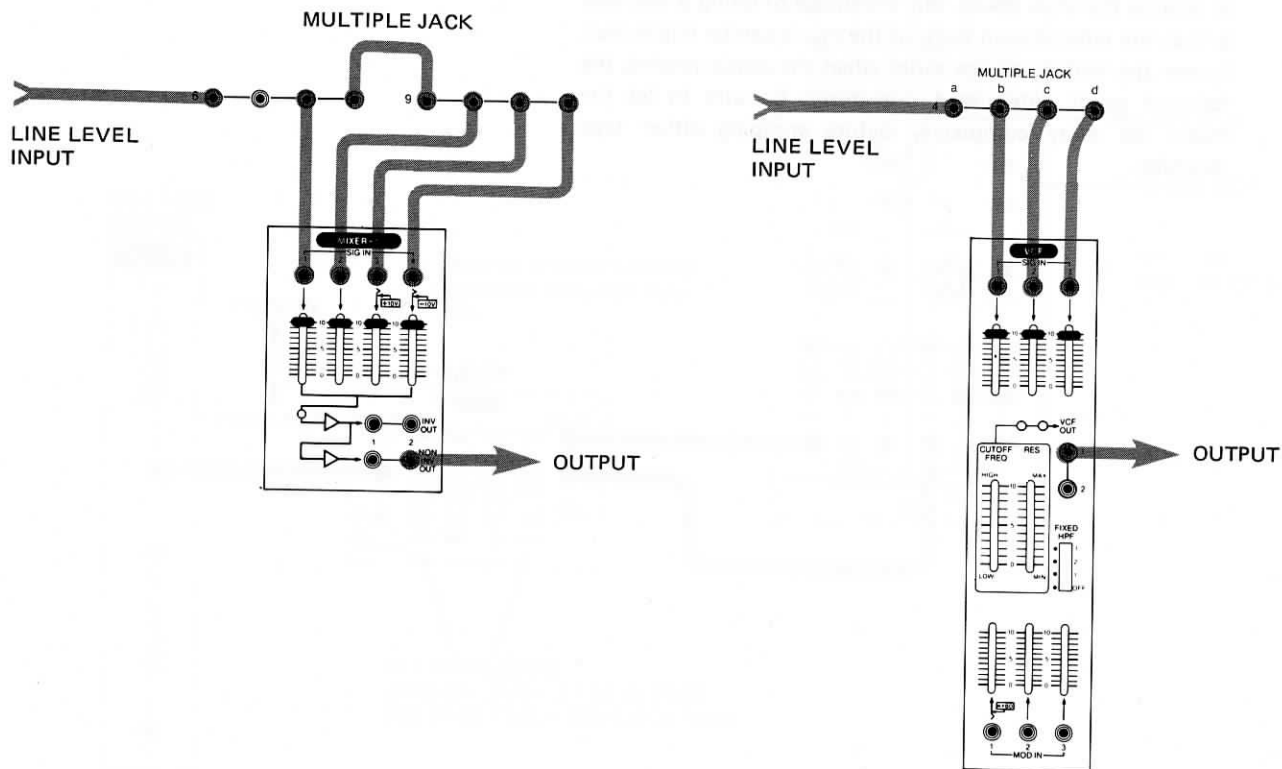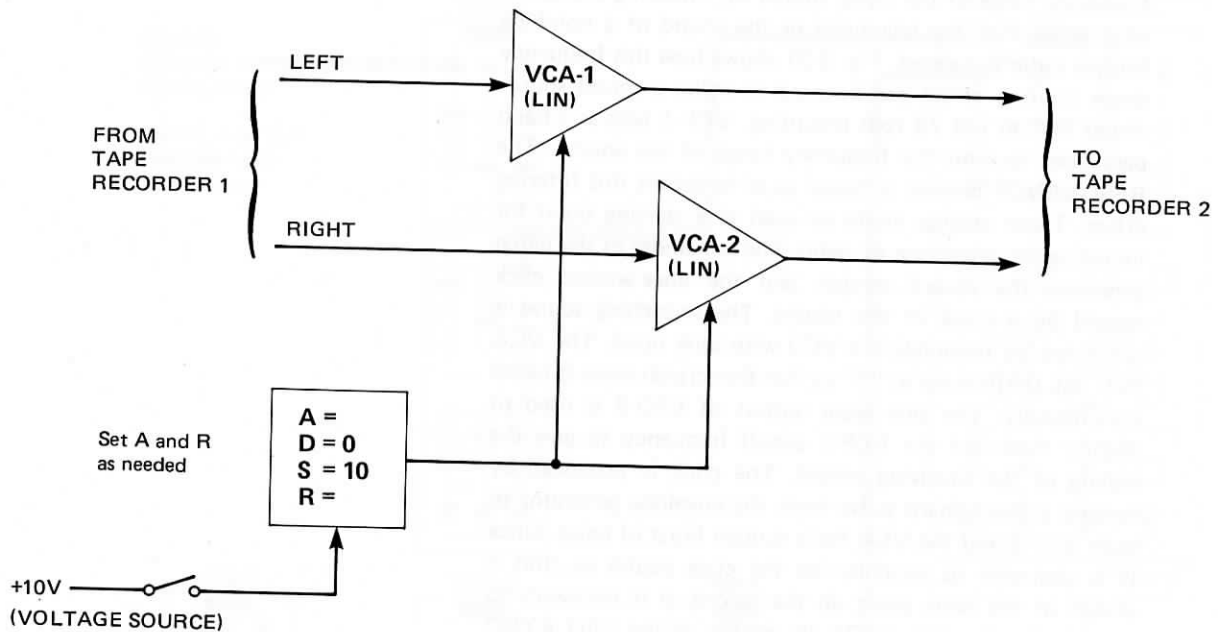MULTIPLE JACK

LINE LEVEL
INPUT

OUTPUT

Fig. 3-30 shows how to produce an automatic fade-in and fade-out. The advantage of this arrangement over manually controlling a mixer is that it will produce fading effects which are smooth and consistently the same. The voltage source is used merely as a convenience so that it is not necessary to hold the envelope generator MANUAL GATE button down for the whole length of a composition. To fade-in, quickly raise the voltage source slider; to fade-out, lower it. The arrangement in Fig. 3-30 can also be used as a gate for tunning a sound source on and off suddenly. It is usually better to avoid setting the envelope generator ATTACK or RELEASE controls at "0". For "instantaneous" on/off effects, set these at slightly above "0".
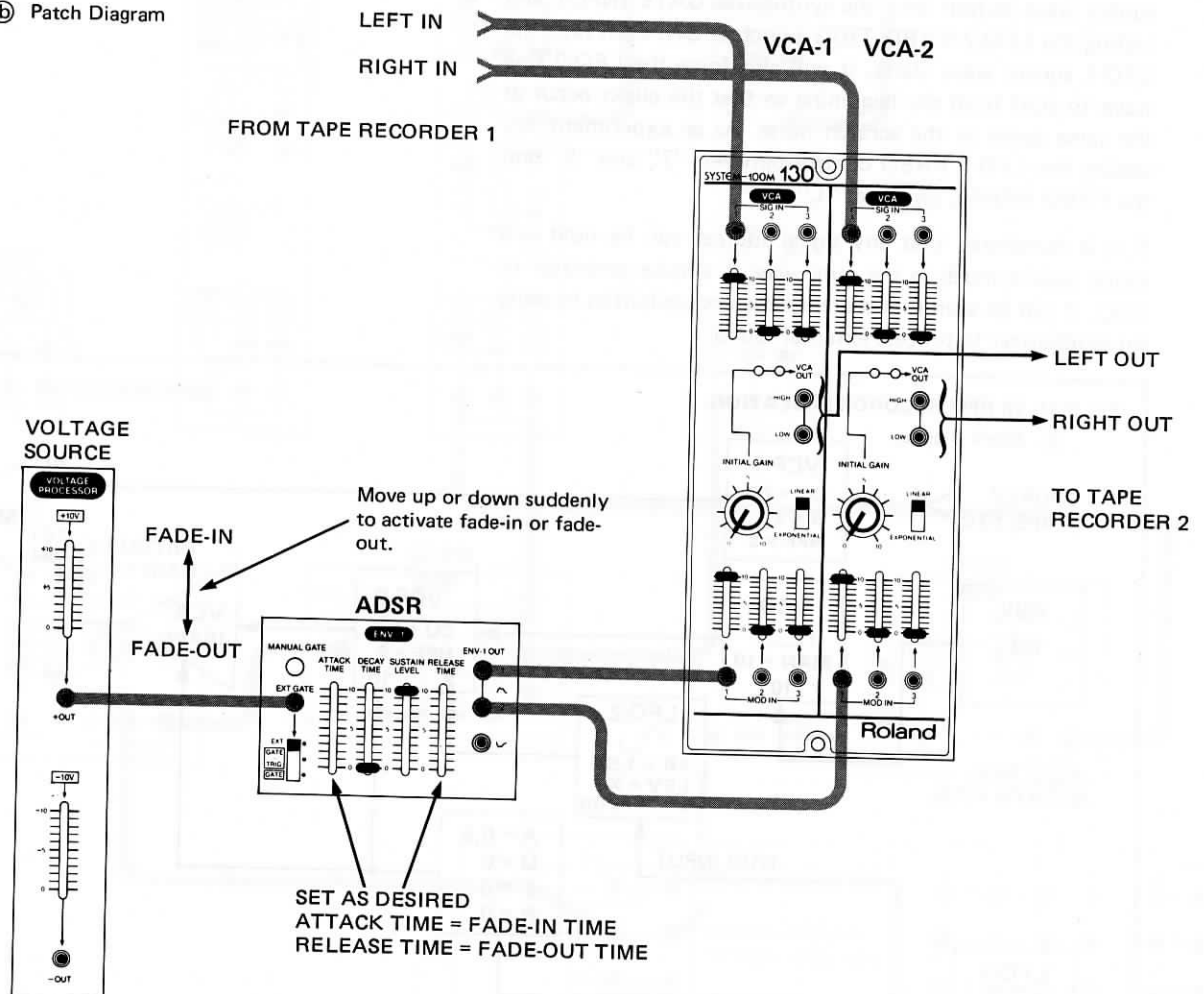
As an example of using the automatic fade, assume a composition which starts with no fade-in but ends with a fade-out. Set the ATTACK control slightly above "0". Thread the tape onto tape recorder 1 and run it to the end of the composition. Experiment to find the best point in the music for lowering the voltage source slider to initiate the fade-out and to determine the best RELEASE TIME setting. Next, return the tape to the beginning of the composition and set the tape so that the opening note or chord is just in front of the playback head. In other words, if the tape recorder is put in the play mode, the music will start immediately. Set the tape counter to "000", then rewind the tape a little more so that the music will not start for several seconds after pressing play. Press play and also start the second recorder in its record mode. Watch the tape counter on tape recorder 1. Just before it turns over from "999" to "000", raise the voltage source slider. With a couple of practice runs, it should be possible to do this so that the music starts almost as soon as the VCA opens. The advantage of doing it this way is that the tape noise in front of the music can be minimized. Lower the voltage source slider when the music reaches the fade-out point determined previously. Be sure to let the music die away completely before stopping either tape recorder.

Fig. 3-30 AUTOMATIC FADE-IN/FADE-OUT

(a) Block Diagram

LEFT

VCA-1
(LIN)

FROM
TAPE
RECORDER 1

RIGHT

VCA-2
(LIN)

TO
TAPE
RECORDER 2

Set A and R
as needed

A =
D = 0
S = 10
R =

+10V
(VOLTAGE SOURCE)

(b) Patch Diagram

LEFT IN

RIGHT IN

VCA-1   VCA-2

FROM TAPE RECORDER 1

SYSTEM 100M 130

LEFT OUT

RIGHT OUT

VOLTAGE
SOURCE

Move up or down suddenly
to activate fade-in or fade-
out.

TO TAPE
RECORDER 2

VOLTAGE
PROCESSOR

+10V

FADE-IN

ADSR

ENV 1

+OUT

FADE-OUT

MANUAL GATE

ATTACK   DECAY   SUSTAIN   RELEASE
TIME   TIME   LEVEL   TIME

ENV-1 OUT

EXT GATE

-10V

EXT
GATE
TRIG
GATE

Roland

-OUT

SET AS DESIRED
ATTACK TIME = FADE-IN TIME
RELEASE TIME = FADE-OUT TIME

The VCF can be used for adding effects to external sound sources. For example, the VCF could be used to limit the frequency range of the signal source for imitating the sound of a voice over the telephone or the sound of a non-high fidelity radio broadcast. Fig. 3-31 shows how this frequency range limiting effect can be used to make a sound source sound like an old 78 rpm recording. VCF-1 acts as a band pass filter to limit the frequency range of the source. The RESONANCE control is raised so as to accent this filtering effect. These settings could be used as a starting point for imitating the telephone or radio. The remainder of the patch generates the record scratch and the once-around click caused by a crack in the record. The scratching sound is generated by modulating a VCO with pink noise. The VCA INITIAL GAIN is set at "7" so that the scratch noise is heard continuously. The sine wave output of LFO-2 is used to slightly modulate the VCF-2 cutoff frequency to give the feeling of the revolving record. The click is produced by feeding a short sharp pulse from the envelope generator to both VCF-2 and the VCA for a sudden burst of noise. Since it is desirable to synchronize the click sound so that it occurs at the same point on the record, it is necessary to synchronize the two LFO's by means of the LFO KYBD TRIG function. This can be done by feeding the LFO-1 square wave output into the synthesizer GATE INPUT and setting the LFO-2 KYBD TRIG switch at ON. Each time the LFO-1 square wave starts, it will also force the LFO-2 sine wave to start from the beginning so that the clicks occur at the same point in the scratch noise. As an experiment, try setting the LFO-2 FREQ control between "7" and "8" and the FREQ RANGE switch at "L".

If it is remebered that any signal sources can be used as a sound source much in the same way as a noise generator or VCO, it can be seen that there are many possibilities in using the synthesizer to process external sound.
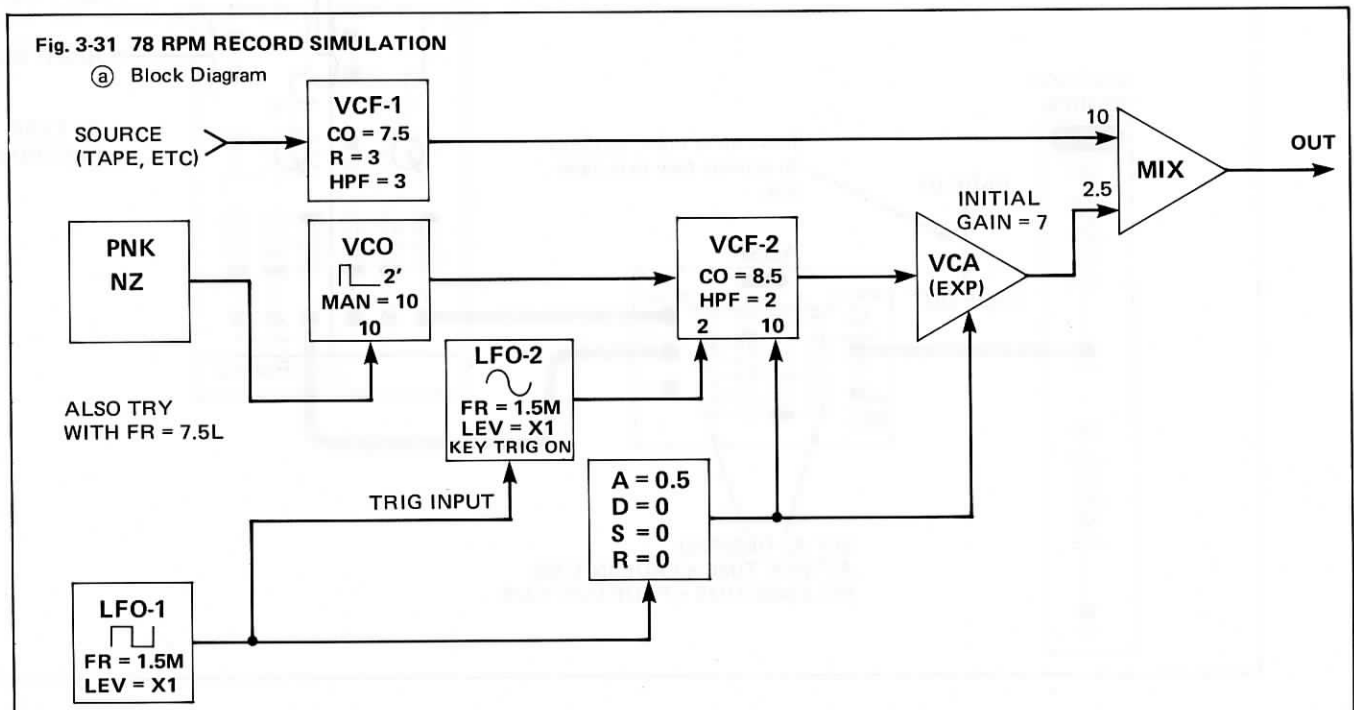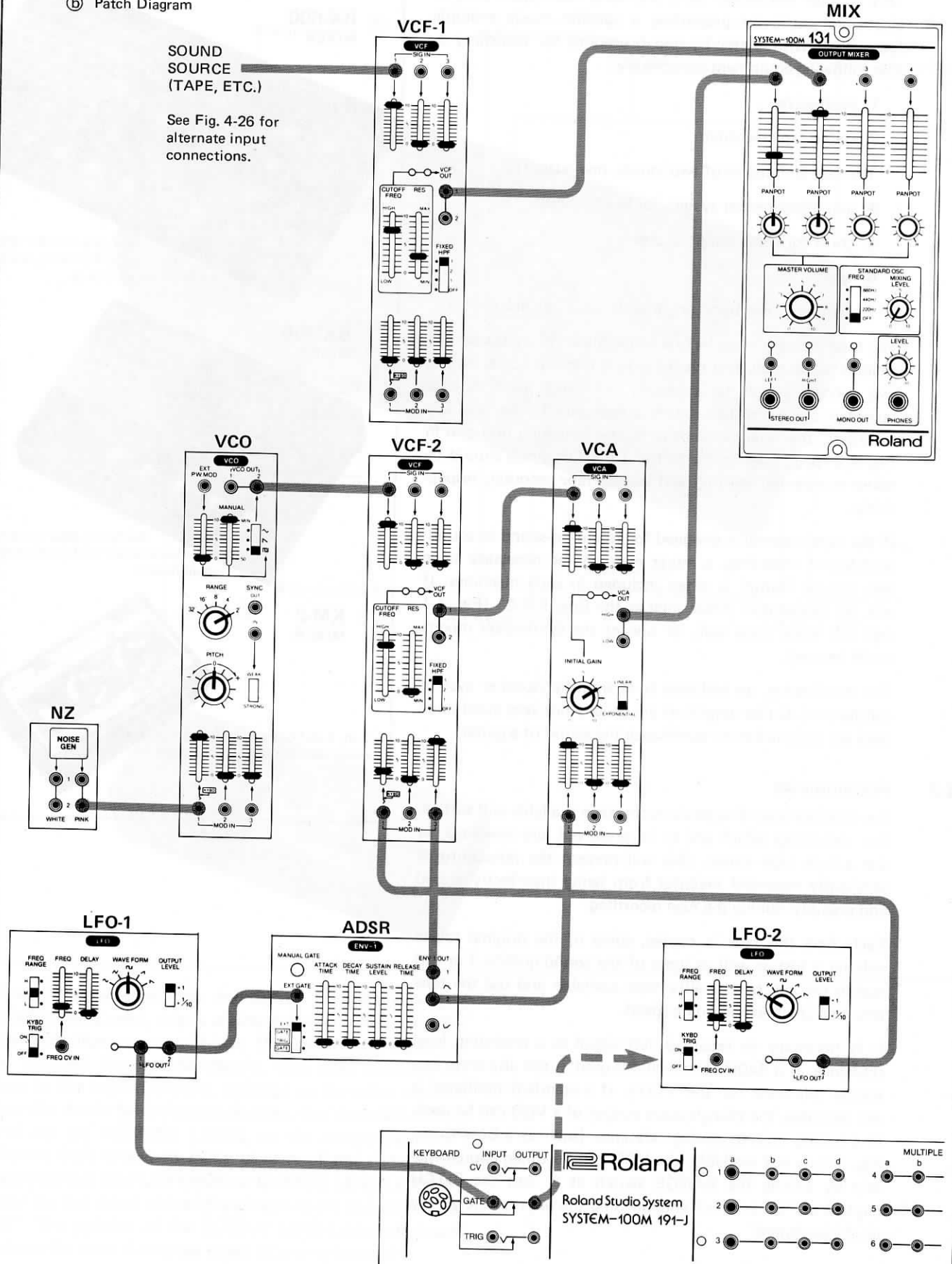

Fig. 3-31 78 RPM RECORD SIMULATION
ⓐ Block Diagram

Fig. 3-31 (cont'd)

ⓑ Patch Diagram

SOUND
SOURCE
(TAPE, ETC.)

See Fig. 4-26 for
alternate input
connections.

VCF-1

MIX

SYSTEM-100M **131**

OUTPUT MIXER

VCO

VCF-2

VCA

NZ

NOISE GEN

LFO-1

ADSR

LFO-2

KEYBOARD

Roland

Roland Studio System
SYSTEM-100M 191-J

Chapter Four:
Sound-on-Sound Recording

4-1 Introduction

This chapter introduces basic recording techniques used in electronic music by presenting a specific music example (page 110) with a step-by-step procedure for recording it. The following equipment is necessary:

1. synthesizer
2. stereo tape recorder
3. mixer (minimum of two inputs, one output)
4. amplifier/speaker system (or headphones)
5. cords for connecting the above
6. tape
7. optional: reverberation, graphic equalizer, foot pedal

The tape recorder must be one which allows playback on one channel while recording on the other. If this is not available, two recorders will be necessary, in which case cassette recorders could also be used. It is necessary to use two tape recorders, the references made in the following text and in Fig. 4-8 (page 104) to the left and right channels should be taken as meaning the first and second tape recorder, respectively.

If the tape recorder is designed for sound-on-sound or sound-with-sound recording, a mixer may not be necessary since this mixing feature is often included in such machines. If not, an inexpensive mixer such as the Boss KM-2* (Fig. 4-1 (e)) will work quite well, or one of the synthesizer mixers could be used.

For monitoring, an ordinary hi-fi amplifier/speaker system can be used. Guitar amplifiers are usually not very good since they are designed more to enhance the sound of a guitar.

4-2 Preliminaries

For practice recording sessions any tape available will suffice. For recordings which are to be preserved, use new tape, or use a bulk tape eraser. This will prevent the possibility of previously recorded material from being inperfectly erased and possibly ruining the new recording.

Each time the tape is copied, some of the original sound volume is lost as well as some of the sound quality. For this reason use the best quality tape available and use the tape recorder's highest recording speed.

It is necessary to record a test signal as a recording level reference. If a 440Hz test signal is used, it can also serve as a tuning reference for the VCO's. If a standard oscillator is not available, the triangle wave output of a VCO can be used. If a tuning fork or tuning reference (such as a Boss tuner; Fig. 4-2) is not available, the VCO can be tuned approximately by setting the RANGE switch at 8' and the PITCH control at "0" (center) and pressing the appropriate **A** key on the keyboard.

---

* Manufactured by Roland

Fig. 4-1 Boss Mixers

(a) **BX-600**
MIXER

6-in, 2-out mixer with panning, effect send, and gain controls on all inputs.

(b) **BX-400**
MIXER

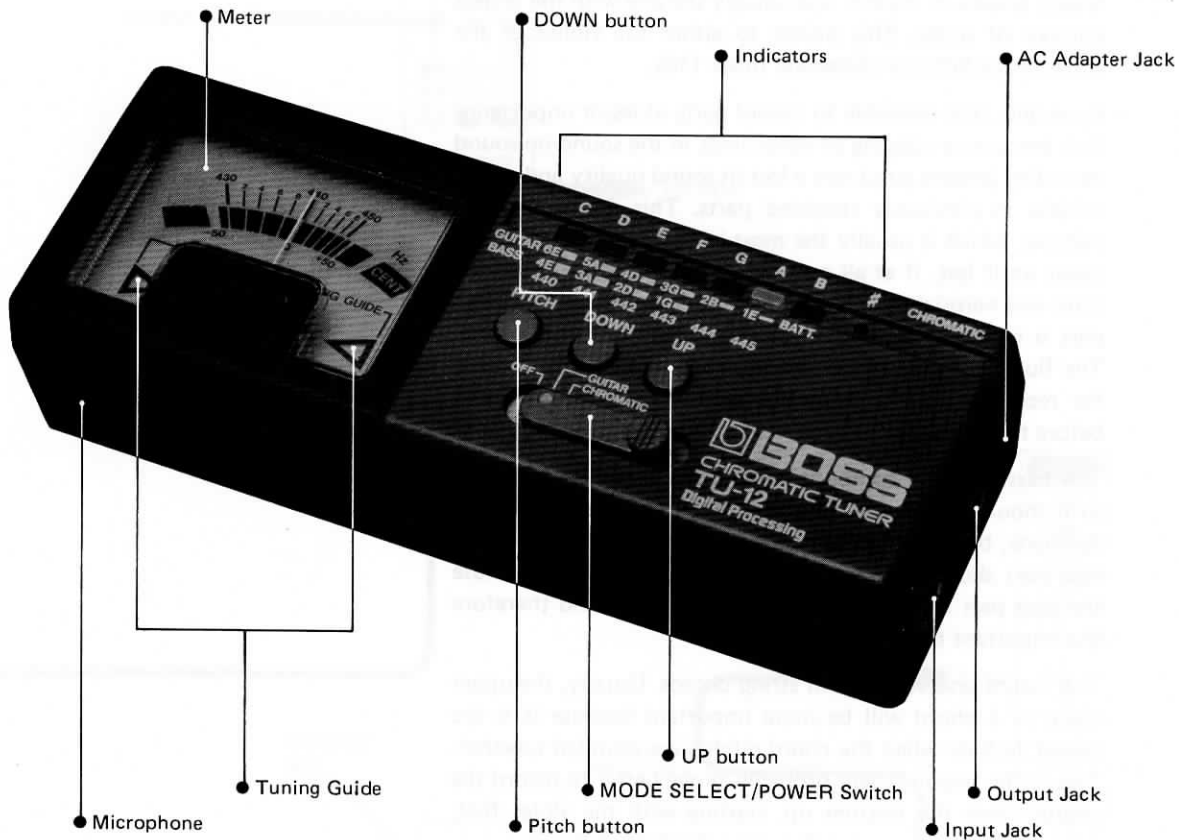Compact, easy-to-carry, 4-in, 1-out mixer with level select switch on all inputs.

(c) **KM-2**
MIXER

2-in, 1-out battery-powered mixer for stage or audio system.

Fig. 4-2 Boss Tuners

ⓐ Model TU-12

- Meter
- DOWN button
- Indicators
- AC Adapter Jack
- Tuning Guide
- Microphone
- UP button
- MODE SELECT/POWER Switch
- Pitch button
- Output Jack
- Input Jack

ⓑ Model TU-12H

The test signal should be recorded on both channels. If a VCO is being used, this is a simple matter when the VCO has more than one output jack. If necessary, the signal can be recorded first on one channel, then after returning the tape to the beginning point, recorded on the other channel, but this should be avoided if possible. Use the LINE INPUT and set the RECORD LEVEL so the meters read "0". Record from fifteen to thirty seconds of test signal. If the tape recorder has PLAYBACK or OUTPUT LEVEL controls, play the test signal and set these levels so the VU meters read "0". The position of the OUTPUT LEVEL controls should remain the same during the entire recording process.

4-3 Deciding the Order for Recording Voices

The best voice for recording first will be the voice with the fewest breaks in rhythm and usually the one with the largest number of notes. This points to either the violins or the violas in the Schubert *Serenade* (page 110).

Generally, it is desirable to record parts of lessor importance first because re-copying of voice lines in the sound-on-sound recording process produces a loss in sound quality and sound volume in previously recorded parts. This means that the melody, which is usually the most important part, should be saved until last, if at all possible. In the *Serenade*, both the flute and harpsichord play melody parts, but the harpsichord part is generally marked to be played softer than the flute. The flute part may be considered more important and saved for recording last, with the harpsichord part recorded just before the flute.

The bass line of a composition will also often be important so it should be recorded just before the melody parts. In the *Serenade*, both the 'cellos and basses form the bass line. The bass part should be recorded before the 'cello part because the bass part is silent a great deal of the time and therefore less important than the 'cello part.

The violins and violas form string chords. Usually, the upper voice in a chord will be more important because it is the easiest to hear when the chord pitches are sounded together. This is the reason it will probably prove better to record the chords from the bottom up, starting with the violas first, followed by the second violins, then the first violins.
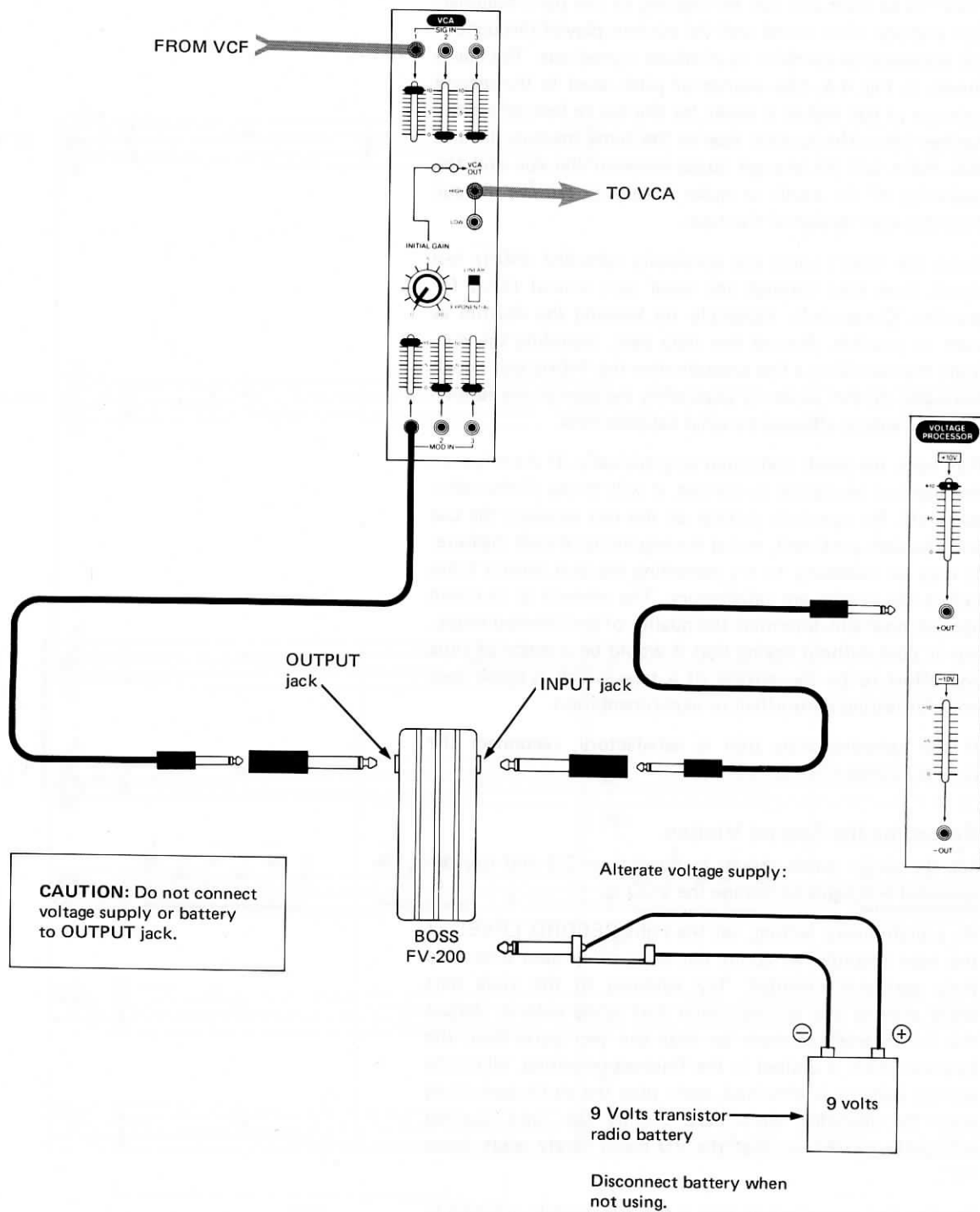
The order in which the voices will be recorded is:

1. Violas
2. Second Violins
3. First Violins
4. Basses
5. 'Cellos
6. Harpsichord, lower pitches
7. Harpsichord, upper pitches
8. Flute

4-4 Recording the Violas

The viola patch is shown in Fig. 2-4. Add more VCO's if they are available. Connect the output of the synthesizer to the left channel LINE INPUT of the tape recorder as shown in Fig. 4-8 (a) (page 104). If the recorder has peak level indicators, set the left channel RECORD LEVEL to just below the point where the indicator flashes when notes are played. A foot pedal may be used for adding dynamics as shown in Fig. 4-3, in which case the RECORD LEVEL should be set with the foot pedal fully depressed.

Fig. 4-3 Foot Pedal for Control of Dynamics

FROM VCF

VCA
SIG IN

VCA OUT

HIGH

LOW

TO VCA

INITIAL GAIN

LINEAR

EXPONENTIAL

MOD IN

VOLTAGE PROCESSOR

+10V

+ OUT

-10V

- OUT

OUTPUT jack

INPUT jack

CAUTION: Do not connect voltage supply or battery to OUTPUT jack.

BOSS
FV-200

Alterate voltage supply:

9 Volts transistor radio battery

9 volts

Disconnect battery when not using.

It is necessary to record a measure or two of rhythmic "tics" to be used as a cue for starting all the parts together. The staccato viola sound and the pattern played throughout the composition combine to produce a good cue. The cue is shown in Fig. 4-4. The change of pitch used in the second measure of cue makes it easier for the ear to hear where the barline falls. The quarter rest in the same measure insures that there will be enough space between the cue and the beginning of the music to make it easy to remove the cue from the final version of the tape.

Tune the VCO's using the previously recorded 440Hz test signal, then play through the viola part several times for practice. Concentrate especially on keeping the rhythm as even as possible. Record the viola part, including the cue. Start the recording a few seconds after the 440Hz test signal. Keep the rhythm as steady as possibly because all the following parts will be affected by what happens now.

Play back the result and listen very critically. If there is even the slightest hesitation in rhythm, it will throw all the other parts off. Be especially critical of the rest between the cue and the viola part itself, and at the beginning of each measure. It may be necessary to try recording the part several times before the results are satisfactory. The amount of criticism applied now will determine the quality of the finished music, but it goes without saying that it would be a waste of time and effort to be too critical of a tape which is being used only for testing some effect or experimentation.

If the recorded viola part is satisfactory, reconnect the system as shown in Fig. 4-8 (b).

4-5 Recording the Second Violins

Set the violin patch shown in Fig. 2-1 or 2-3 and use the recorded test signal to re-tune the VCO's.

As a preliminary setting, set the right RECORD LEVEL of the tape recorder at about the same place used when the viola part was recorded. Try listening to the viola part while playing the second violin part along with it. Adjust the mixer level controls so that the two parts have the balance which is desired in the finished recording. When the correct balance is obtained, again play the violin part along with the recorded viola part. Adjust the right channel RECORD LEVEL so that the VU meter rarely reads above "0".

Practice the second violin part a few times while listening to the viola part. When the practice runs are satisfactory, try recording. Start the tape before the cue so that all of the cue is recorded on the new track. Listen critically to the results. Again, it may be necessary to record several times before the results are satisfactory.

At the end of this step, the left channel will contain the viola part alone and the right channel will contain both parts.

Fig. 4-4 Cue for Schubert *Serenade* shown on page 110

4-6 Recording the First Violins

Reconnect the system as shown in Fig. 4-8 (c). Use the test signal to check the VCO tuning. If desired, alter the violin patch settings slightly to give the feeling of violins which are different from the previously recorded violins. Adjust the mixer level controls so that the parts have the balance desired in the finished recording, then adjust the left channel RECORD LEVEL so that the left VU meter rarely goes over "0".

Practice the first violin part, then record it. When recording, be sure that all of the cue part is also recorded on the new track. At the end of this step, the right channel will contain the violas and second violins and the right channel will contain the complete string chords.

4-7 Recording the 'Cellos and Basses

Set the string bass patch shown in Fig. 2-6 and, if desired, try the equalizer settings shown in Fig. 4-5. Tune the VCO's using the recorded test signal. Remember that the bass part should sound one octave below the pitches as written. In other words, if the **A** above middle **C** on the keyboard is pressed, the VCO's should produce a pitch one octave below the 440Hz test pitch. Try playing the bass part along with the previously recorded string chords. Adjust the mixer level controls so that the parts have the balance which is desired in the finished recording, then adjust the right channel RECORD LEVEL.

Practice and record the bass part. When the results are satisfactory, reconnect the system as shown in Fig. 4-8 (e), then record the 'cello part in a similar manner. Use the 'cello patch shown in Fig. 2-5.

4-8 Recording the Harpsichord Part

The harpsichord part consists of an upper and a lower voice line. The lower line can be considered less important than the upper line; therefore, the lower line should be recorded first. The sound produced by the patch in Fig. 4-6 was purposely designed to be more electronic sounding than a natural harpsichord. The lower voice is recorded first using arrangement shown in Fig. 4-8 (f) with the methods outlined above, followed by the upper voice using the arrangement in (g).

The string sounds use at least two VCO's each; therefore, precise tuning of the VCO's is not important. In fact, the effect is much better if the VCO's are very slightly off-pitch, one VCO being slightly above the correct pitch and the other slightly below. The harpsichord sound uses only one VCO and accurate tuning is very important. For this reason, tune the VCO as accurately as possible, using the recorded test signal, immediately before recording each harpsichord part.

It is possible to use an electronic piano or similar instrument for the harpsichord part, in which case both the **upper** and lower voices could be recorded at the same time to reduce the number of recording steps necessary. Recording the harpsichord would become step (f) and recording the flute would then become step (g) in Fig. 4-8.
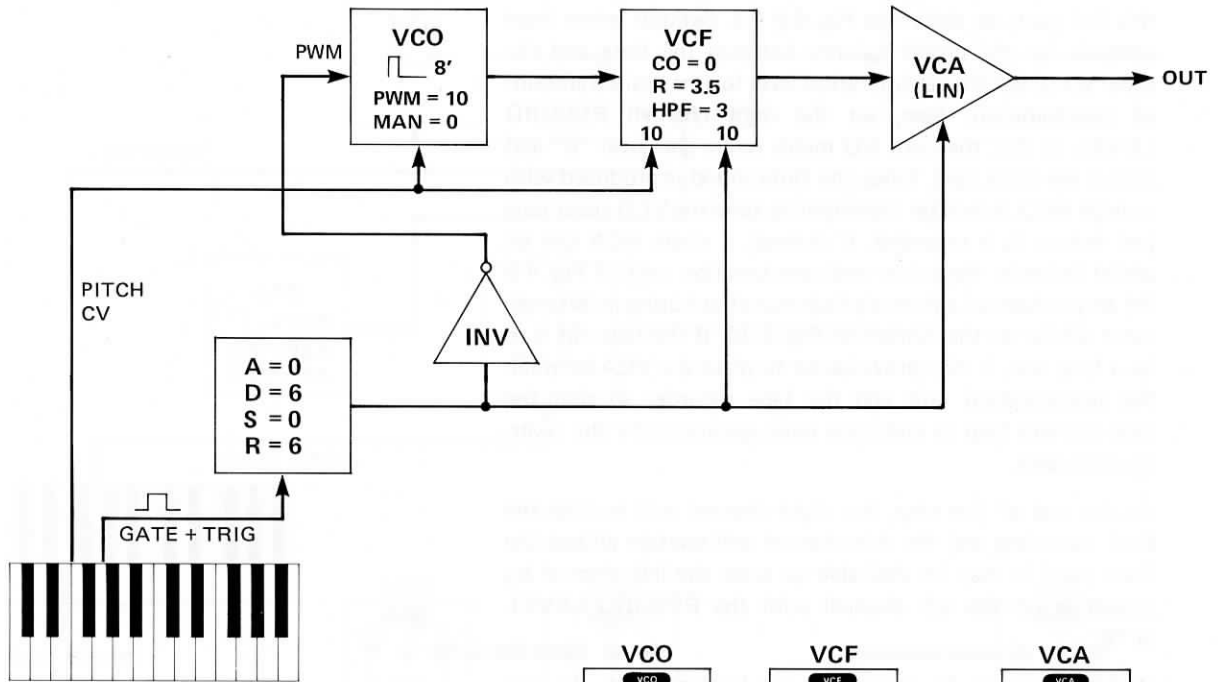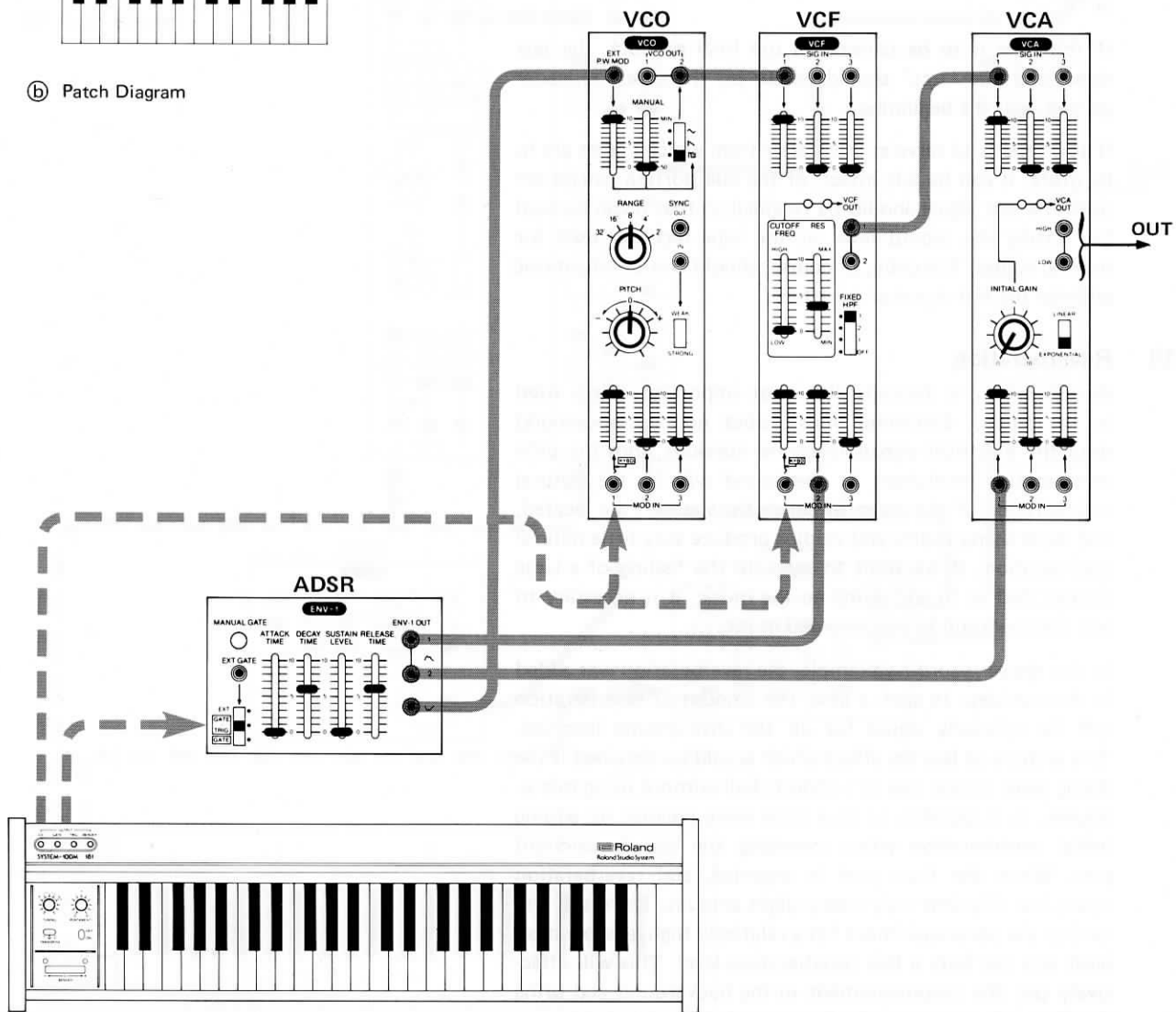

Fig. 4-5 Equalization for String Bass Sound
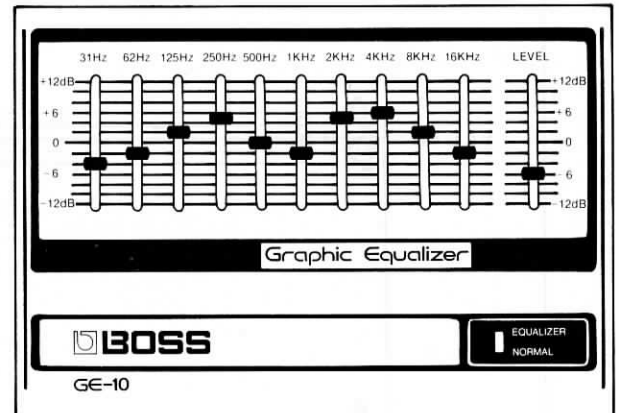
(Compare these settings with the settings shown in Fig. 4-4 d of Volume 1)

Fig. 4-6 HARPSICHORD

ⓐ Block Diagram

ⓑ Patch Diagram

4-9 Recording the Flute

Use the flute patch shown in Fig. 4-7. If reverberation effect is desired, it can be added during the recording of this last part, as shown in Fig. 4-8 (h). Set the mixer level controls for the proper balance between the flute and the other parts. Set the reverberation level for the desired amount of reverberation. Last, set the right channel RECORD LEVEL so that the right VU meter rarely goes over "0" and record the flute part. Since the flute sound is produced with a single VCO, it will be important to tune the VCO accurately just before it is recorded. If desired, a single VCA can be added between the mixer and reverberation unit of Fig. 4-8 (h) to produce an automatic fade-out effect using an arrangement similar to that shown in Fig. 3-30. If the fade-out is to be a long one, it may prove better to place the VCA between the reverberation unit and the tape recorder so that the fade-out will help to eliminate noise generated by the reverberation unit.

At the end of this step, the right-channel will contain the final recording and the left channel will contain all but the flute part. It may be desirable to erase the left channel by recording on the left channel with the RECORD LEVEL at "0".

If this tape is to be considered the final product, the test signal and cue "tics" should be cut off the tape and leader spliced in at the beginning.

If this tape is to serve as the master from which copies are to be made, it can be left intact, or the cue portion can be cut out. The test signal should be retained so that it can be used for setting the record level of the tape recorder used for making copies. The copy, of course, should contain the music without the test signal or cue "tics".

4-10 Reverberation

Reverberation is perhaps the most important effect used in the studio. Electronic music does not become sound until the electrical signals reach the speakers, thus the only reverberation contained in the sound will be the natural reverberation of the room in which the speakers are located, and most living rooms and studios produce very little natural reverberation. If we want to recreate the feeling of a large concert hall or to add depth to the music, it is necessary to add reverberation to the recorded music.

In the above recording example, the reverberation was added in the last step. In such a case, the amount of reverberation will be relatively equal for all the instruments involved. This is more or less the effect which would be obtained if the music were played live in a concert hall without using microphones. It is possible to be a little more creative by adding initial reverberation when recording the last harpsichord part. When the flute part is recorded, add reverberation again, but this time only a very slight amount. The result will be that the accompaniment has a relatively high reverberation level and the flute a low reverberation level. This will effectively put the accompaniment in the background and bring the flute solo more into the foreground where it belongs.
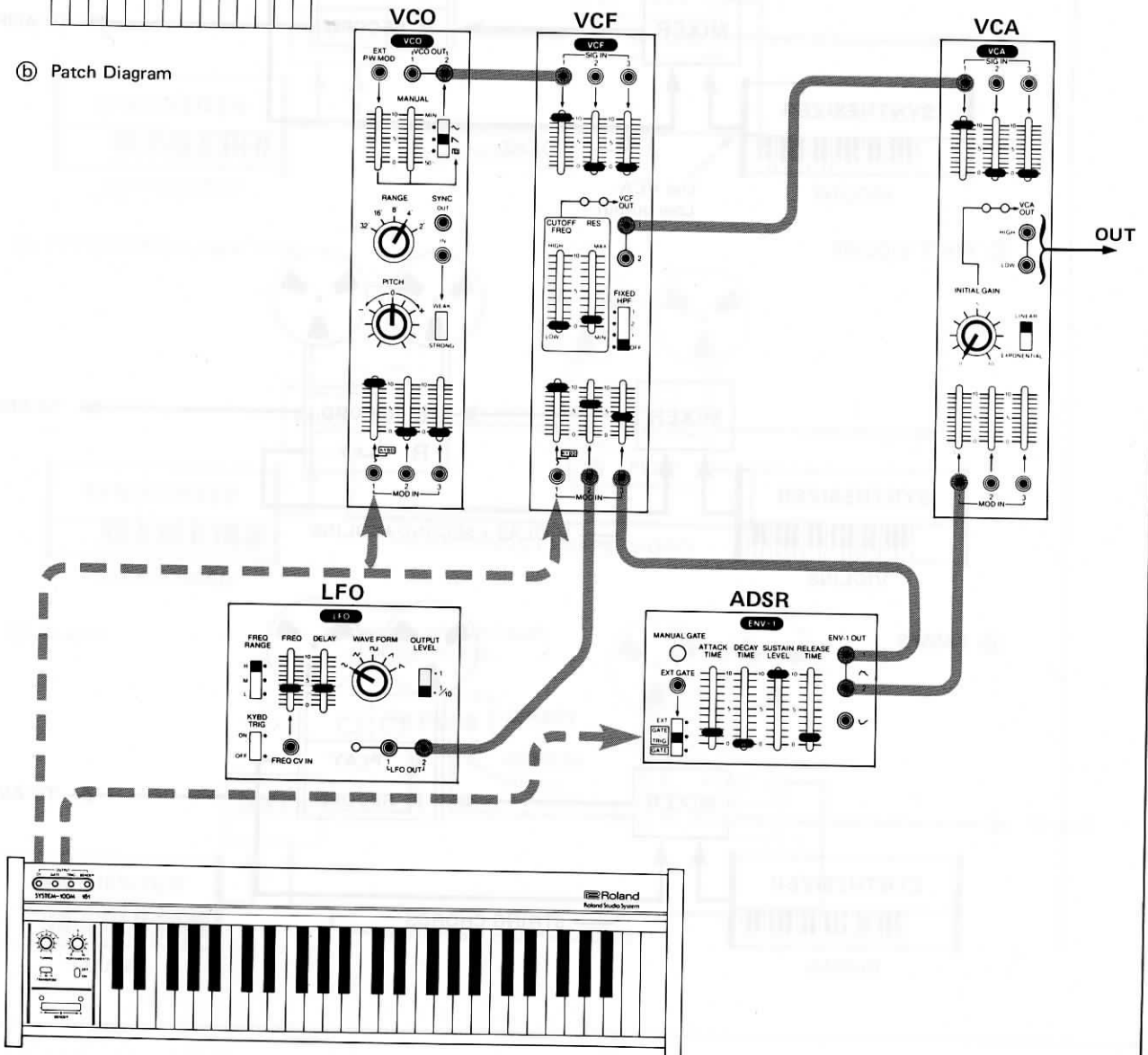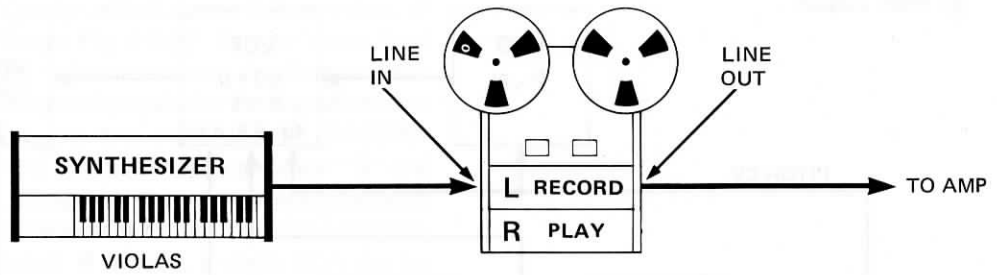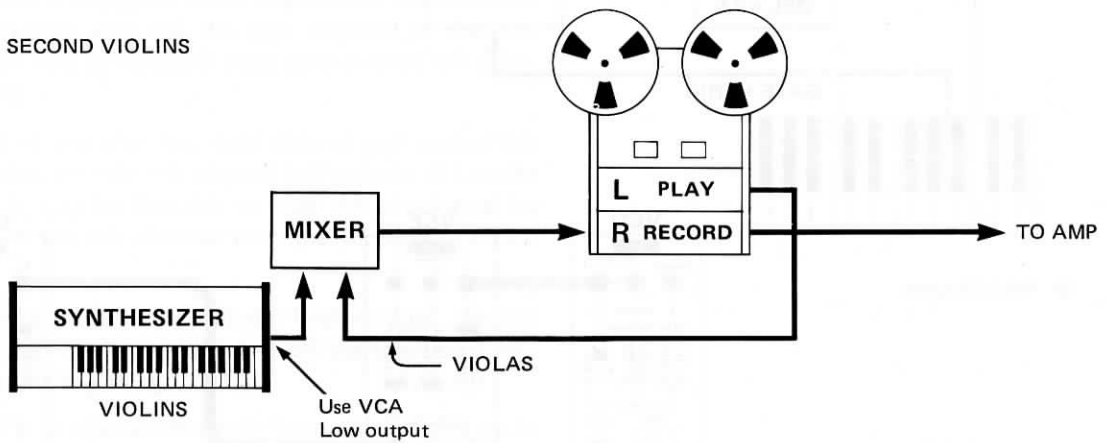
Fig. 4-7 FLUTE

(a) Block Diagram
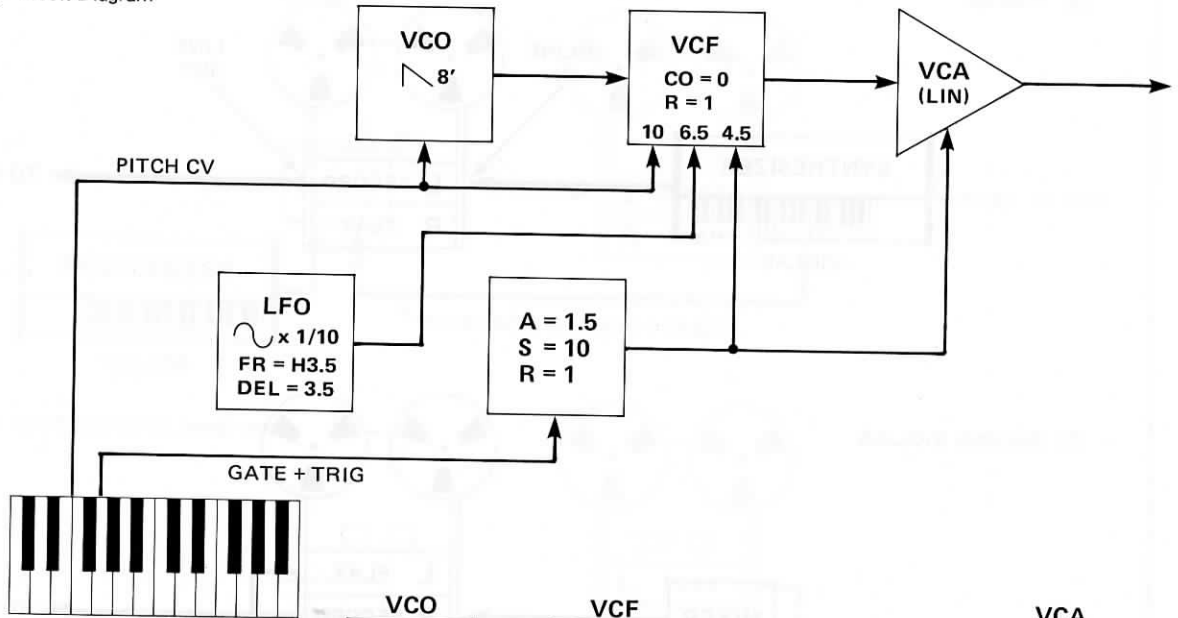
VCO
∖ 8'

VCF
CO = 0
R = 1
10 6.5 4.5

VCA
(LIN)

PITCH CV

LFO
∿ × 1/10
FR = H3.5
DEL = 3.5

A = 1.5
S = 10
R = 1

GATE + TRIG

(b) Patch Diagram

VCO

VCF

VCA

OUT

LFO

ADSR

Fig. 4-8 Sound-on-Sound Recording

ⓐ VIOLAS

LINE IN

LINE OUT

SYNTHESIZER

VIOLAS

L RECORD

R PLAY

TO AMP

ⓑ SECOND VIOLINS

MIXER

SYNTHESIZER

VIOLINS

Use VCA Low output

L PLAY

R RECORD

TO AMP

VIOLAS

ⓒ FIRST VIOLINS

MIXER

SYNTHESIZER

VIOLINS

L RECORD

R PLAY

TO AMP

VIOLAS + SECOND VIOLINS

ⓓ BASSES

MIXER

SYNTHESIZER

BASSES

L PLAY

R RECORD

TO AMP
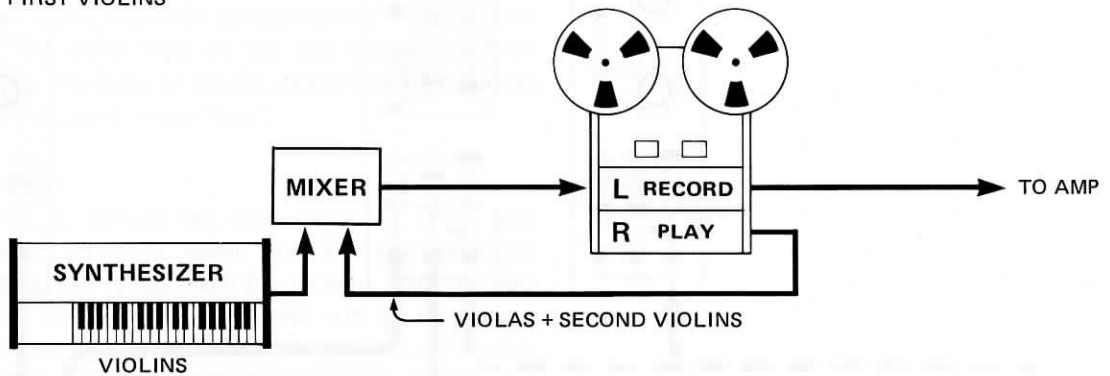
STRING CHOROS
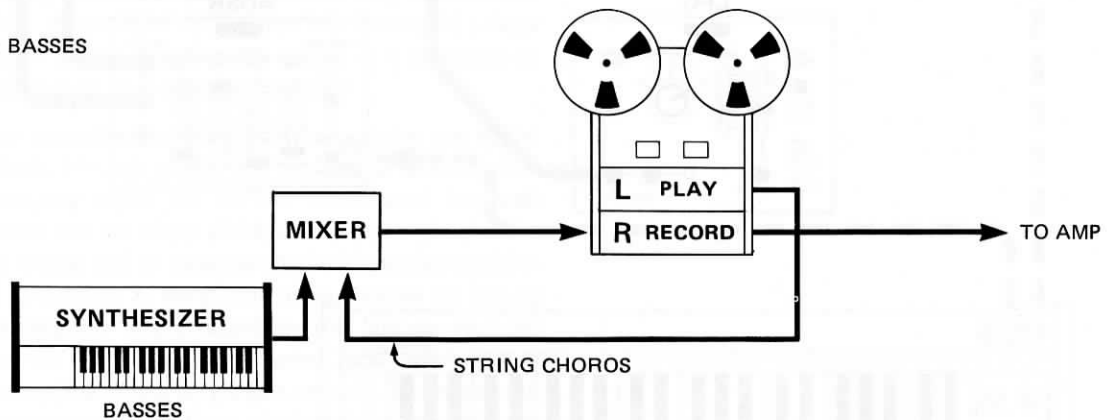
Fig. 4-8 Sound-on-Sound Recording (cont'd)

ⓔ 'CELLOS

MIXER

SYNTHESIZER

'CELLOS

L RECORD

R PLAY

TO AMP

STRING CHORDS + BASSES

ⓕ HARPSICHORD, lower voice

MIXER

SYNTHESIZER

HARPSICHORD

L PLAY

R RECORD

TO AMP

STRINGS

ⓖ HARPSICHORD, upper voice

MIXER

SYNTHESIZER

HARPSICHORD

L RECORD

R PLAY

TO AMP

STRINGS + HARPSICHORD

ⓗ FLUTE

Reverberation unit such
as BOSS RX-100

REVERB

DIRECT
+
REVERB
output

MIXER

SYNTHESIZER

FLUTE

L PLAY

R RECORD

TO AMP

STRINGS + HARPSICHORD
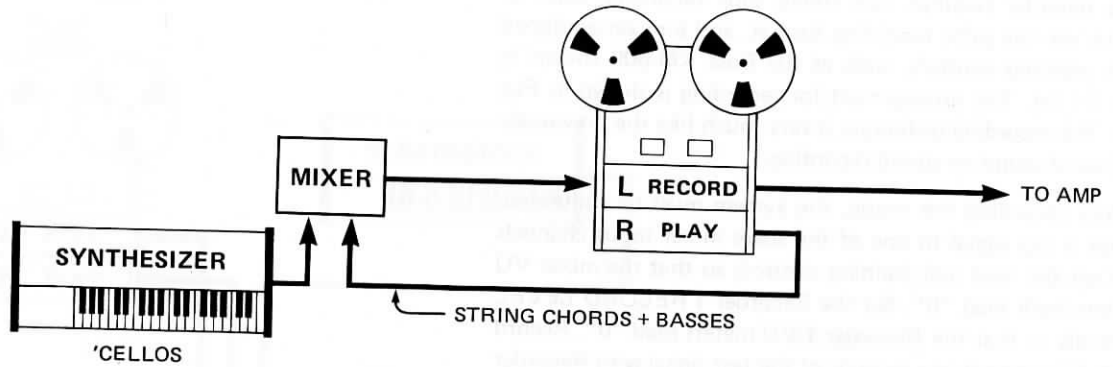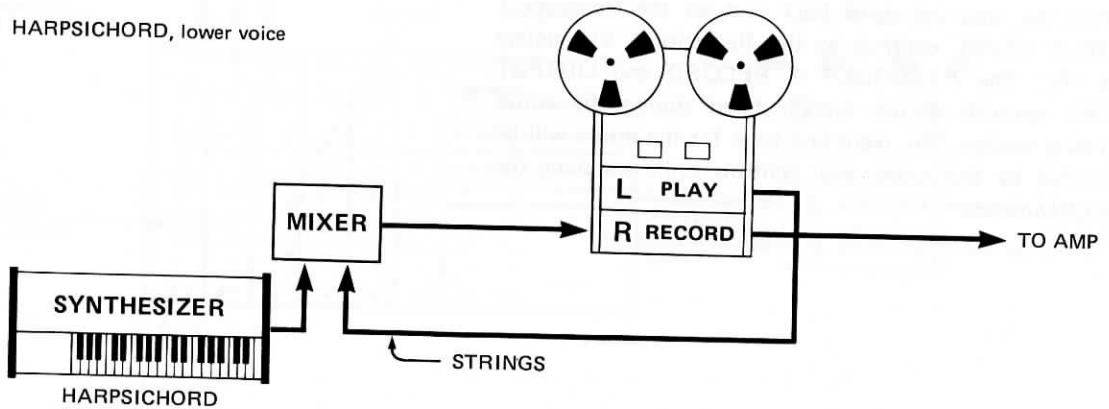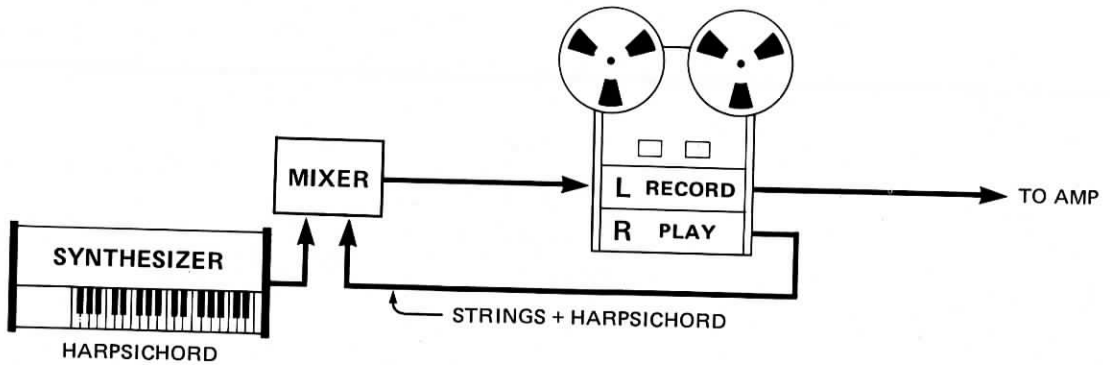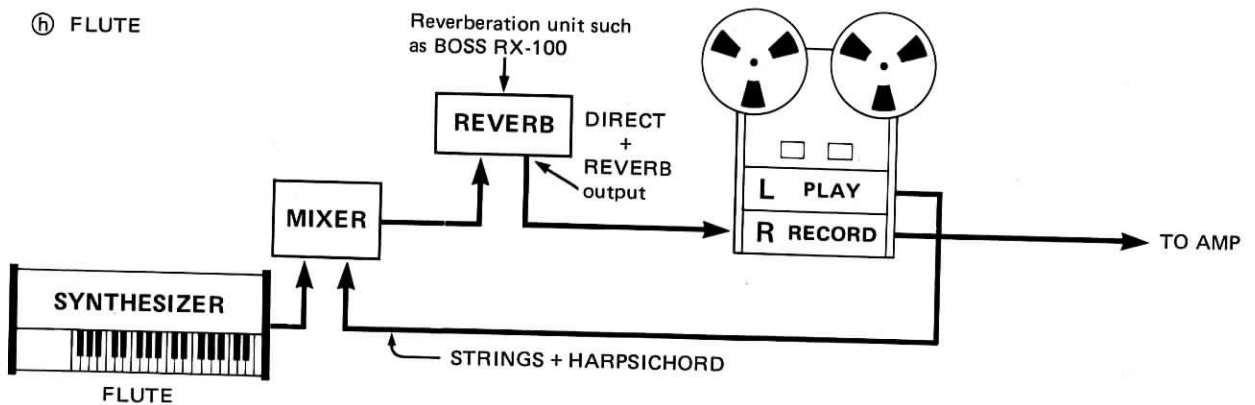
4-11 Stereo Recording

To make a stereo recording without the use of a multichannel tape recorder requires two stereo tape recorders, both of which use the same recording format, and a mixer equipped with panning controls, such as the Boss KM-600 shown in Fig. 4-1 (c). The arrangement for recording is shown in Fig. 4-9. The recording technique is very much like the previously discussed sound-on-sound recording.

Before recording the music, the system must be calibrated. Input a test signal to one of the spare mixer input channels and set the level and panning controls so that the mixer VU meters both read "0". Set the Recorder 1 RECORD LEVEL controls so that the Recorder 1 VU meters read "0". Record from fifteen to thirty seconds of the test signal with Recorder 1. Play the recorded signal back and set the Recorder 1 OUTPUT LEVEL controls so the Recorder 1 VU meters read "0". The RECORDER 1 RECORD and OUTPUT LEVEL controls should remain fixed during the entire recording session. The recording level for the music will be controlled by the mixer level controls while watching the mixer VU meters.

Fig. 4-9 Stereo Recording

RECORDER 2

PLAY
MODE

SYNTHESIZER

RECORDER 1

RECORD
MODE

INPUTS

Set as
desired

MIXER

L PLAY

R PLAY

PANNING
CONTROLS

CHANNEL 1 CHANNEL 2 CHANNEL 3 CHANNEL 4 CHANNEL 5 CHANNEL 6   SEND LEFT-MONO RIGHT   POWER
                                                           EFFECT RETURN   L OUTPUT R

1 2 3 4 5 6 **BOSS BX-600**
                  6 CHANNEL STEREO MIXER
                  POWER

GAIN GAIN GAIN GAIN GAIN GAIN

EFFECT EFFECT EFFECT EFFECT EFFECT EFFECT

PANPOT PANPOT PANPOT PANPOT PANPOT PANPOT

PEAK INDICATOR

EFFECT VOLUME

VOLUME VOLUME VOLUME VOLUME VOLUME VOLUME

LEFT RIGHT

LEFT RIGHT

MASTER VOLUME

L RECORD

R RECORD

L OUTPUTS

R

To MONITOR Amp
and SPEAKERS

Set levels as desired,
but both should be the
same.

To record the *Serenade* example and produce stereo string sounds, use a chorus machine, such as is shown in Fig. 4-10, and set the system up as shown in Fig. 4-11. Set the channels 1 and 2 level controls at minimum. With the channels 3 and 4 panning and level controls set as shown, adjust the master level controls so that both mixer VU meters read approximately the same, but not too high, when playing the viola part. Record the viola part with the cue shown in Fig. 4-4 just after the previously recorded test signal.

To prepare for the second violin part, remove the tape from Recorder 1 and thread it onto Recorder 2. Play the test signal portion of the tape and set the Recorder 2 OUTPUT LEVEL controls for "0" on the Recorder 2 VU meters. Set the mixer channels 1 and 2 panning controls as shown in Fig. 4-11. Set the mixer level controls so that playing the test signal produces "0" on the mixer VU meters. Thread a second tape onto Recorder 1. Record a test signal by copying the test signal from the tape now on Recorder 2. The reason for copying the test signal is that if there is even a slight difference in speeds between the two recorders, the new test signal would be of a slightly different pitch from the music which is to be recorded with Recorder 2 and, therefore, would not represent an accurate tuning reference.

To record the second violins, set all the panning controls as shown in Fig. 4-11. All the level controls will be operated in pairs. The channels 1 and 2 level controls are set the same so as to form one pair which, in this step, controls the level of the previously recorded viola part. The channels 3 and 4 level controls are set the same as each other to form a second pair which, in this step, controls the level of the second violin part which is to be added to the music. The master level controls are also set the same to form a pair which controls the overall output level of the mixer.

To avoid adding unwanted noise to the music, the channel level controls should always be set relatively high and the master level controls relatively low while maintaining the proper VU meter readings. To do this and still produce the desired balance between the old and new parts can sometimes be a little confusing. Start by setting the channel level controls as shown in Fig. 4-11. Next, while producing sound, temporarily set the master level controls so that the mixer VU meters read below "0". Play the old and new parts together and adjust the channel levels for the desired balance. When adjusting, always try to set the balance by raising one pair of level controls rather than lowering. In other words, if it is desired to make the viola part a little softer than the violin part, raise the violin level controls rather than lowering the viola controls. The viola controls would be lowered only if the violin controls were to reach maximum without producing the desired balance. When the balance is correct, set the master level controls for the correct VU meter reading. In this way, the channel levels will remain relatively high and the master levels relatively low.

Fig. 4-10 Chorus Machines

ⓐ Boss CE-3

ⓑ Roland SDE-3000 Digital Delay

ⓒ Roland SDD-320 Dimension D

Fig. 4-11 Using a Chorus Machine for Stereo Strings
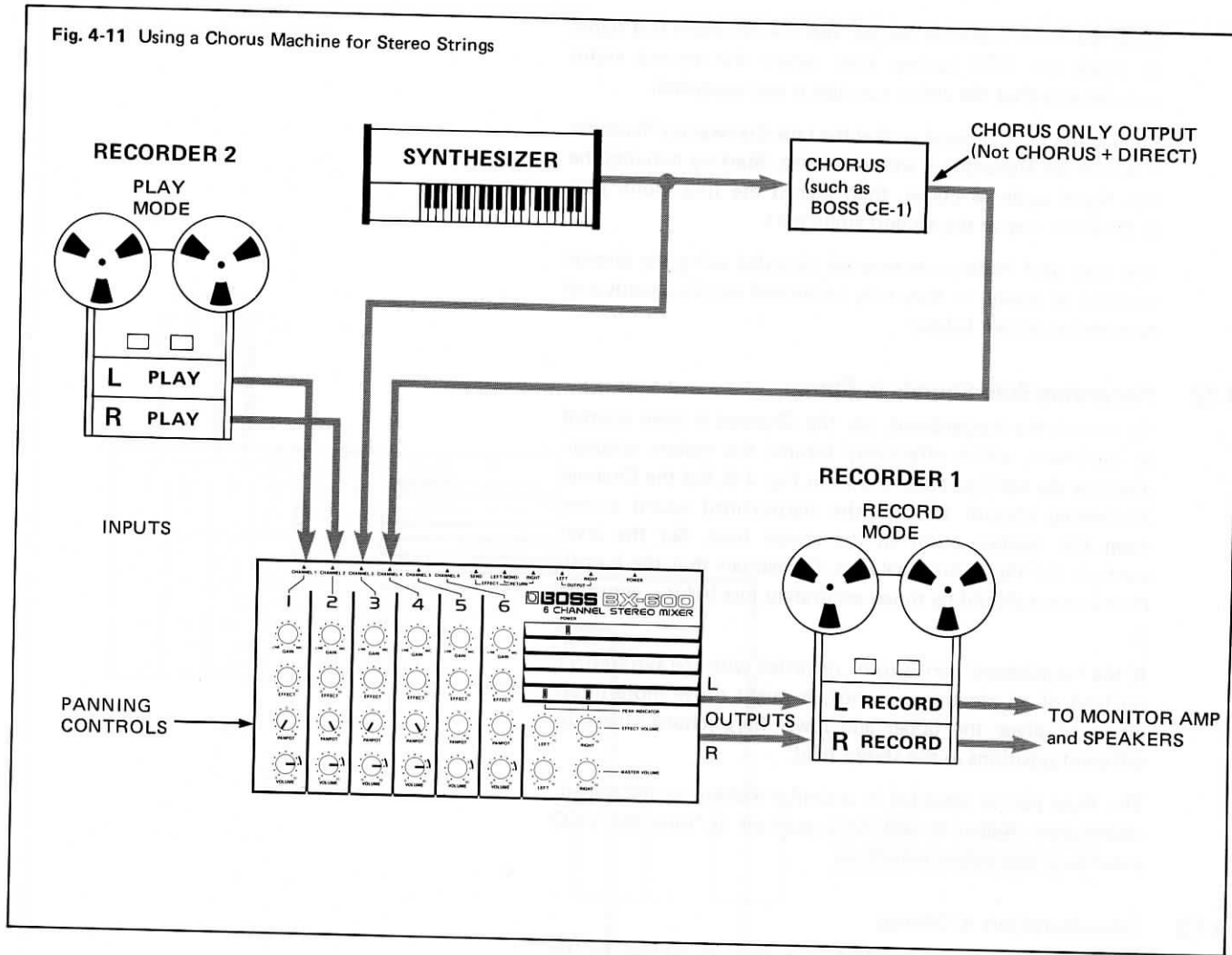
Once the mixer controls are set, use the recorded test signal to check the VCO tuning, then record the second violin part. Be sure that the entire cue part is also recorded.

Change the tapes around so that the tape that was on Recorder 1 is now on Recorder 2 and vice versa. Start by copying the test signal again as above, then record the first violin part in the same way as the second violin part.

The bass and 'cello parts may be recorded using the chorus machine as above, or they may be treated as solo sounds and recorded as shown below.

4-12 Recording Solo Sounds in Stereo

To record the harpsichord, set the Channel 4 level control at minimum, which effectively returns the system arrangement to the configuration shown in Fig. 4-9. Set the Channel 3 panning control so that the harpsichord sound comes from the desired point in the stereo field. Set the level controls for the desired balance. Remember that the harpsichord sound should be tuned accurately just before recording it.

If the harpsichord part is to be recorded with the synthesizer (instead of an electronic piano), it might prove more interesting to place the upper and lower harpsichord voices in different positions in the stereo field.

The flute part is recorded in a similar manner as the harpsichord part. Again, it will be important to tune the VCO accurately just before recording.

4-13 Reverberation in Stereo

Reverberation can be handled in a manner similar to the sound-on-sound technique, but using two reverberation units, as shown in Fig. 4-12. Add initial reverberation to the strings, then add a small amount of reverberation to the flute and possibly the harpsichord as well.

Multichannel Recording for Electronic Music, published by Roland, expands on the electronic music recording process by presenting techniques useful with four tracks and larger recording systems.

Fig. 4-12 Stereo Reverberation

INPUTS

OUTPUTS

L

R

OPTIONAL POSITION FOR MONO
REVERB UNITS SUCH AS THE
BOSS RX-100 REVERB ADD.

L RECORD

R RECORD

TO MONITOR AMP
and SPEAKERS
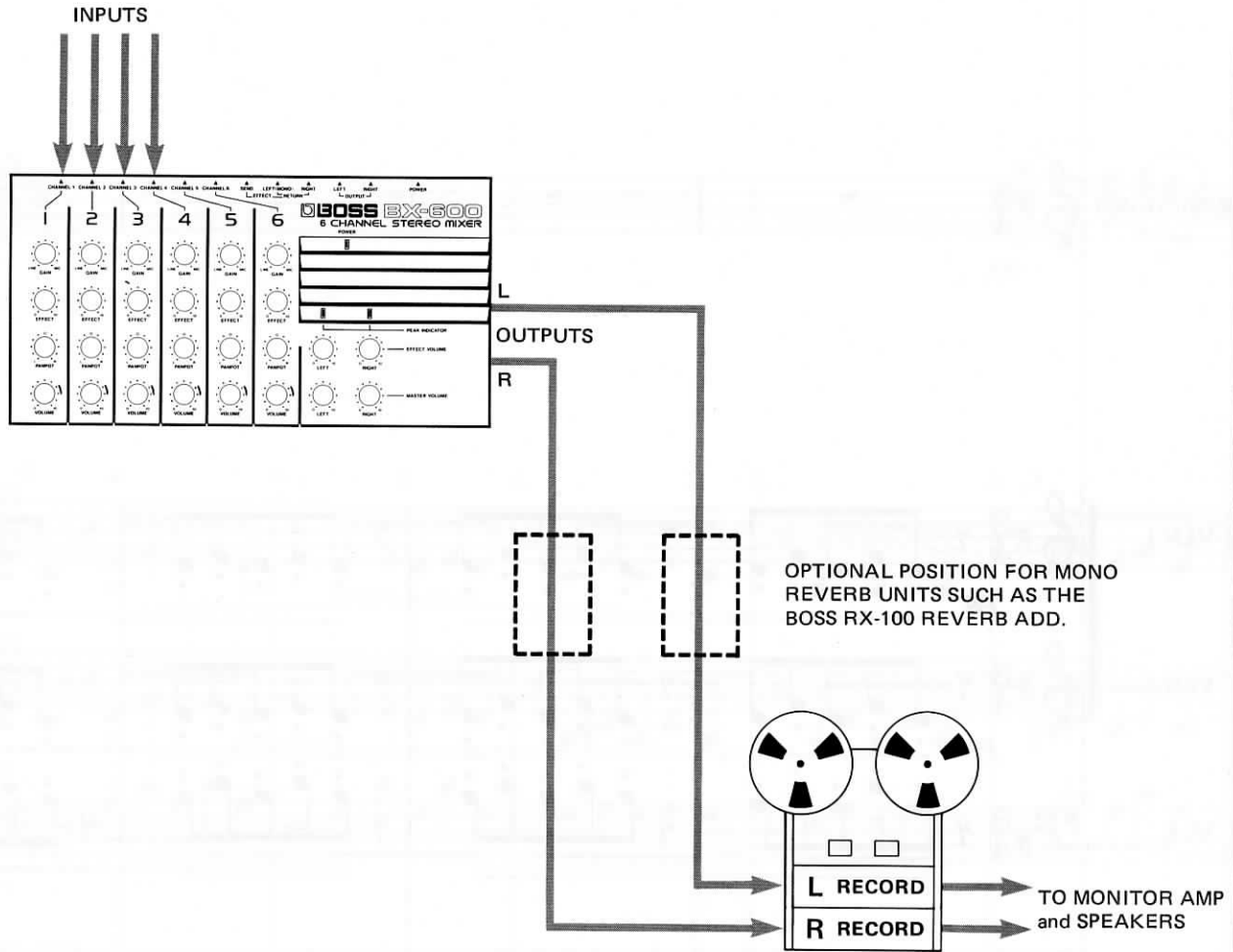
Serenade (Schubert)

SERENADE

F. Schubert
Ar. by R. Graham

① . See NOTE 1, p. 117.

Serenade (Schubert)

NOTES TO THE SCORE

1. The viola part has been written in the bass cleft for convenience to keyboard players who may not be familiar with the usual alto cleft:
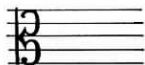
2. The bass cleft is never used with true violin music. Its use here illustrates one of the major advantages of imitative synthesis: the synthesizer can produce pitches far above and below the normal range of the instrument being synthesized.

LOWEST VIOLIN PITCH: **LOWEST VIOLA PITCH:**

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