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Music

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VOUSSOIRS FOR LARGE ORCHESTRA AND ELECTRONIC TAPES

DISSERTATION

Presented in Partial Fulfillment of the Requirements for
the Degree Doctor of Musical Arts in the Graduate
School of The Ohio State University

By

Stephen Rowley Montague, A.A., B.M.E., M.M.

* * * * *

The Ohio State University
1972

Approved by

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Special thanks also go to my Committee, Doctors Marshall Barnes, Richard Hoppin and Norman Phelps for reading the boring text and looking at the wierd score, and to Ms. Donna Reichert for her untiring help during the final struggle.

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Studies in Composition. Marshall Barnes, Herbert Brün,
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Studies in Music Theory. Norman Phelps, Ronald Pellegrino,
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Studies in Music History. Keith Mixter and Richard Hoppin

LIST OF ILLUSTRATIONS

Figure	Page
1. An Avant-Garde Mobile	5
2. Charles Ives' <u>4th Symphony</u>	9
3. Krzysztof Penderecki's <u>De Natura Sonoris</u> ..	10
4. The Flow Charts for the Electronic Tape patches	22-36
5. The graphic illustration of <u>Voussoirs</u> , First Movement	40
6. The graphic illustration of <u>Voussoirs</u> , Second Movement	41
7. Seating arrangement of the orchestra	53

TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	ii
VITA	iii
LIST OF FIGURES	iv
INTRODUCTION	1
Chapter	
I. THE ANTECEDENTS	4
II. THE COMPOSITIONAL PROCEDURES	21
Media	
Electronic Tapes	
Meter, Rhythm, and Tempo	
Form	
III. PERFORMANCE NOTES	52
Seating Arrangement	
Conductor	
Tape Recorders	
Notation	
BIBLIOGRAPHY	57

INTRODUCTION

"Music is now so foolish that I am amazed. Everything that is wrong is permitted and no attention is paid to what the older generation wrote as composition."¹ These were the words bellowed by the composer-organist Samuel Scheidt near the end of his life in 1651. His cry echoes the familiar, age-old wail of the outraged "establishment" lamenting the excess and barbarism of the young upstarts. The eras have changed, but not the polemics. The heavy wagon-train of musical progress still plods slowly and cautiously across the newly-won lands, following with cool circumspection the rugged new trails blazed by the scouts and pathfinders of the avant-garde. Today, as the number of new territories being discovered and explored increases, the definition of music becomes increasingly vague. Now, more than two or three decades ago, there is a great deal more consternation trying to answer Herbert Brün's probing question: "At what point does an acoustical event become a musical event?"² The composer today has, in addition to traditional sound sources,

¹Joseph Machlis, The Enjoyment of Music. (New York: Norton, 1970), p. 479.

²Herbert Brün, Distinguished Visiting Professor of Electronic Music, 1969-1970, assigned this question as the subject of a paper for his Seminar in Electronic Music, 838, Winter, 1970.

discovered the use of numerous electronic devices to aid and augment his compositional palette. This technology, spawned by the sciences, has unlocked nearly as many aesthetic doors as scientific and provided some fantastic new instruments for powerful, new forms of expressive art.

A widely used term which includes this aspect, as well as many other aspects of experimental music, is "avant-garde." In spite of certain commercial erosions into its original meaning, the term "avant-garde" aptly describes "... an area of composition that thrives on constant conceptual and technical renewal, where new musical discoveries are made, and where continual reappraisal and refinement of compositional process is taking place.¹ The avant-garde is, in short, the "growing edge" of musical evolution.²

The styles, technics, and philosophies of the avant-garde composers today are wonderfully varied and diverse. It seems, however, that no matter what their compositional style or philosophy electronics, either in sound generation or reproduction, has been instrumental in their work. Electronics as a tool for musicians has expanded to the extent that it is no longer associated, as it was in the 1950's, with any particular style or school of composition. Synthesized sound, live performers accompanied by electronic tape, multitrack recording, computer music, live performances on home-made

¹"Forward," Source, Vol. I (Davis, California: Composer/Performer Editions, 1967), p. 1.

²Ibid.

circuitry, multimedia, circuitry designed to modify vocal and instrumental sounds, bio feed-back brain-wave concerts, and the numerous other electronically derived compositions are some examples of the wide diversity to which electronic means have now been applied.

The present score, Voussoirs for Large Orchestra and Electronic Tapes, is a representative product of one aspect of the current scene which combines traditional sound sources with some of the electronic means now available to the composer in the late Twentieth Century.

CHAPTER I

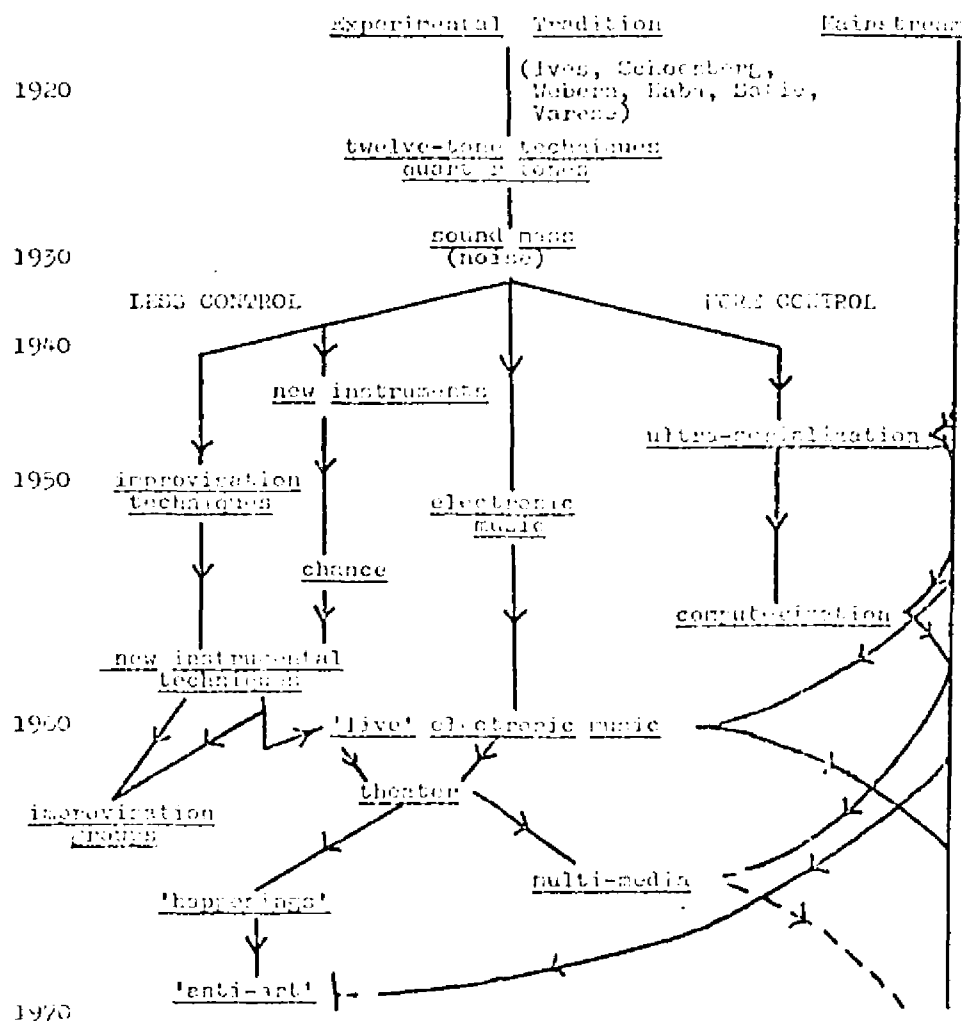
THE ANTECEDENTS

Voussoirs for Large Orchestra and Electronic Tapes

springs from that genre of late Twentieth Century musical expression which concerns itself more with texture, timbre, and instrumental color than with rhythm, harmony, melody and form. It is a product influenced both by the great European and American experimental music traditions. (Figure 1) Of the European influences, the line of heritage has arrived at its present stage through the innovative compositions of Berlioz, Wagner, Debussy, Stravinsky, Schoenberg, Bartok, Boulez, Stockhausen, and Ligeti. The influential American precursors can be traced through some of the works and philosophies of Ives, Cowell, Varese and Cage, but as Ives rightly lamented in the "Epilogue" to Essays Before a Sonata, there is a certain "...futility [in] attempting to trace the source or primal impulse of an art inspiration ..."¹ The inception or "primal impulse" to create Voussoirs can only be summarized as a desire on the part of the composer to create something.

¹Howard Boatright (ed.), Charles Ives' Essays Before a Sonata, The Majority, and other Writings. (New York: Norton, 1970), p. 70.

Figure 1
An Avant-Garde Mobile¹



The influence of other composers and compositions on the final realization of this desire, however, is the subject of this chapter.

¹David Cope, New Directions in Music (Dubuque, Iowa: W. C. Brown, 1971), p. 2.

The immediate and perhaps the most obvious influence in the creation of Voussoirs is the orchestral music of György Ligeti and Krzysztof Penderecki - more specifically, Apparition (1958-59) and Atmospheres (1961) of Ligeti and De Natura Sonoris (1966) of Penderecki. These works represent the basic models from which Voussoirs was conceived.

Apparition, which is the earliest of these three compositions, is a two movement work with the movements joined attacca. The subject matter, if indeed that term is valid in such a work, is a series of varying dense and thin clusters that shift, slide, and are transformed by very carefully notated, precise orchestration. One of the most interesting features of Apparition, however, is the formal concept. The textures in both movements, though initially sounding quite different from each other, are actually quite similar in overall shape and pattern. The second movement creates a kind of allusion to the first. This basic concept appealed to me and served as a basic structure over which Voussoirs was constructed. Although the Ligeti work was the immediate model for the general constructional attempt, this concept for unification of seemingly disparate movements by some kind of subtle link is by no means a new idea. The interest in creating some kind of unifying force between movements and within each movement permeates recent Western music in one way or another. One has only to examine the past interest in cyclic form, key relationships, texts, cantus firmus technique, or any of the other attempts to unify works to see the importance such practices manifest in the compositions of the West. This

preoccupation with the subtle unifying elements is still visible in a great deal of avant-garde music today.

Atmospheres and De Natura Sonoris are both one movement works which served as models for the construction of the first movement of Voussoirs. Atmospheres is composed in a very sinewy style which gives the impression of gradual, at times, imperceptible transformations of textures which, only after numerous listenings seem to unfold as a kind of large three-part form. The first (the beginning to Figure G) and the last sections (from N to the end) bear not only some textural and coloristic similarities, but also have identical tempo markings ($\text{♩} = 40$). De Natura Sonoris, on the other hand, has much more obvious sectional divisions and the arrangements of events more commonly employs abrupt changes rather than gradual transformations. There is, nevertheless, a similarity in unifying techniques which include textural sequences and coloristic patterns, between De Natura Sonoris and Atmospheres. Voussoirs utilizes both the gradual transformation of events found in the Ligeti work and the sudden, abrupt changes typical of the Penderecki work. As the name implies, Voussoirs is constructed with "wedges" of sound which serve as the primary unifying elements as well as the basic units of construction.

The use of shifting bands of dense or thin half-step clusters found in Voussoirs have, of course, over the past decade become a trademark of many of the Polish avant-garde composers such as Lutoslawski, Penderecki, Baird, Seroki,

Dobrowolski, and Gorecki, but this technique was actually first explored by the American musical pioneers, Charles Ives and Henry Cowell in the early part of this century. An early use of dissonant bands of sound is found in many of the orchestral works of Charles Ives and particularly in the last movement of the 4th Symphony. There is similarity between the way Ives constructs numerous layers of sound (Figure 2) in his work and the manner in which Penderecki uses materials in De Natura Sonoris (Figure 3). Ives' use of sound bands in which the multiplicity of activity within the band is such that it creates only the effect of rustling movement on a grand scale without the listener's being able to focus on any particular or specific melodic line. This particular device is used in many of the current avant-garde orchestral works including Apparition, Atmospheres, De Natura Sonoris, and Voussoirs. Although Ives is usually the composer given credit for first utilizing clusters, Henry Cowell is most often the composer associated with the exploitation of this technique.¹ The dense bands of half-step clusters so common in a great deal of European avant-garde music and to a lesser extent in American avant-garde camps, were incorporated in many works of Henry Cowell beginning with The Tides of Manaunaun written in 1911 and in works of Edgar Varèse such as Ionisation (1931) and Equatorial (1937).

The advent of electronic music in 1948 provided new vitality to this concept of "harmony" since indeterminate

¹Eric Salzman, Twentieth Century Music: An Introduction (Englewood Cliffs, N.J.: Prentice-Hall, 1967), p. 152.

Figure 2

Charles Ives - 4th Symphony, p. 15

Conductor I — $\frac{6}{8}$ (♩. 50)
 Conductor II — Basses (♩. 80) and cue Bassoons (♩. 70)

↓ Allegretto (♩. of $\frac{6}{8}$ 50)

Clarinets in B♭

Take cue from Cond. II, then freely to ~

Bassoons

Piano

Orchestra Piano

Celesta

Triangle

High Bells

Low Bells

Light Gong

Heavy Gong

Solo Piano

Allegretto (♩. of $\frac{6}{8}$ 50)

Violins div.

Vas

Cellos

Basses

Violoncello

Double Bass

Conductor

Movement II: Copyright 1929 by Charles E. Ives

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Figure 3

Krzysztof Penderecki - DeNatura Sonoris, p. 17

Figure 3 shows a musical score for Krzysztof Penderecki's DeNatura Sonoris, page 17. The score is divided into two main sections, labeled (I) and (II).

Section (I): This section includes staves for various instruments and voices, marked with dynamics *p* (piano) and *f* (forte). The instruments listed are:

- fl (flute)
- ob (oboe)
- sxf (saxophone)
- fg (fingerboard)
- cr (clarinet)
- tr (trumpet)
- tn (trombone)
- vn (violin)
- vl (viola)
- vc (violin)
- vb (violin)

Section (II): This section includes staves for various instruments and voices, marked with dynamics *ppp* (pianissimo) and *f* (forte). The instruments listed are:

- picci (piccolo)
- cl (clarinet)
- cl b (clarinet)
- flxt (flute)
- pf (piano)
- arm (arm)
- vn (violin)
- vl (viola)
- vc (violin)
- vb (violin)

The score is written in a complex, non-standard notation, with many notes and rests. The dynamics *p* and *f* are used throughout, indicating a range of volume. The notation includes various symbols, such as *sub p*, *ppp*, and *f*, which are used to indicate specific performance instructions.

pitched sounds were some of the first and most basic sound sources available on the early electronic equipment. The rapid growth and wide dissemination of electronic studios in the 1950's and 1960's were undoubtedly influential in the continued interest of using sound bands of clusters. The works of the Polish avant-garde in particular, with its linear oriented sound band spectrums are, in many ways, a direct result of the popularization of electronic music over the past two decades. Most of the composers currently active in the avant-garde have, at one time or another, worked with electronic music. Ligeti, for instance, worked for a short time in the late 1950's with electronic means and produced an electronic tape and score called Artikulation.¹

It is curious to see and hear the similarities in style between his electronic work and the works he composed shortly thereafter -- Apparition and Atmospheres. It has been my experience too that working in The Ohio State University Sound Laboratory with electronic equipment, whose inherent sound production is long unbroken patterns of wave forms, has reshaped many of my compositional ideas both for electronic means with live performers and for scoring music for traditional instruments alone.

An attempt to neutralize the powerful force of the traditional rhythmic pulse and periodicity inherited from the "common practice period" has been one of the goals that

¹György Ligeti, Artikulation (Mainz, Germany: B. Schott's Sohne, 1970. An electronic tape score with a recording of a realization.

characterizes much of the compositional practice since the late Nineteenth Century. The evolution of pulse and rhythmic patterns from the early florid figures of Gregorian Chant to the rigorous pulsations and unflagging rhythmic patterns in Baroque music have now evolved to the point where there is a practice on the part of many avant-garde composers to use a kind of non-periodic, free, fluid, rhythmic state in which structures, textures, instrumental colors, and harmonies are not to be perceived as patterns within underlying rhythmic pulse, but independent events occurring in an unmarked linear time scheme. The long struggle in the Nineteenth and early Twentieth Centuries to emancipate the rhythmic element from the "tyranny of the bar line" has largely been accomplished by many avant-garde composers active since about 1950.¹

Stravinsky's early attempt at relocating accents in order to eliminate the feeling of traditional four bar periodicity and the inevitability of the traditional accents in 3/4 and 4/4 meter was successful to the point that it created a different order. Stravinsky used rhythm in a much more plastic way than had been practiced in the three centuries before, but at approximately the same time the same problem was being attacked in another way by Charles Ives and Edgar Varèse. While Stravinsky and others such as Bartok sought to revitalize the rhythmic element in music through rearrangement of bar lines and accents, Ives attempted in several works to

¹Richard DeLone, Music-Patterns and Style (Reading, Mass: Addison-Wesley Publishing House, 1971), pp. 397-400.

fracture and fragment rhythmic figures to the point of nearly obliterating the basic sense of pulse altogether. A wonderful example of this technique is again found in the last movement of Ives' 4th Symphony (Figure 2) where at times the rhythmic figures are so small and so diverse that there is only the sense of motion about it, and almost no remnant of the traditional pulsation found in Western music since the Renaissance. This same technique is employed to a greater extent in Voussoirs where the rhythmic figures have been so fragmented and are so minute that at many points there is only a notion of movement in space and no underlying pulse in the traditional rhythmic sense. While there is a certain degree of periodicity at some points in Voussoirs, a true emancipation from the traditional "squareness" of the bar line is found in much of the accompanying electronic tape music, and especially in the "Interlude" between the first and second movements.

Melody, in the strictest sense of the traditional definition, does not exist in Voussoirs. Since the beginnings of Western music, this element has been the primary unit for conveying a musical idea, and its evolving shapes and changing patterns have been the subject of numerous scholarly tracts.

The melodies preserved in the recorded history of Western civilizations show a general trend of evolving from mostly step-wise progressions to patterns involving very wide

ranges and numerous chromatic alterations. From many avant-garde composers' point of view, the practice of chromatic melodic lines in the late Nineteenth and early Twentieth Centuries reached the point of redundancy within the equal-tempered scale by about the middle of this century. For many composers like John Cage, Edgar Varèse, György Ligeti, Krzysztof Penderecki, Earle Brown, and Robert Ashley, this was a time for new compositional elements to replace the traditional concept of melody. In Voussoirs, as well as in many of the orchestral works written earlier in the 1950's and 1960's, "melodic lines" on numerous planes create colorful atmospheric events which have changed the meaning and function of melody. No longer is melody a kind of high profile element that recurs at strategic points in a composition under various transformations and guises. Melody in these avant-garde camps exists only to serve as a kind of moving linear force whose primary purpose is to help produce the larger sonic effect.¹ What appears to be melodic material on the printed pages is usually so vertically and horizontally profuse that it is aurally perceived as a kind of agglomerate, shimmering, cluster rather than a series of melodic lines. The multiplicity of "melodic" lines on different planes destroys the individuality of the specific

¹It is only fair to mention, however, that although many avant-garde composers, especially European, consider traditional melodic formulas moribund as a cogent musical expression. Terry Riley, Steve Reich, Phillip Glass, and other avant-garde American composers of the younger generation seem to have found new possibilities in the use of modal melodies in the context of Eastern musical structures.

line and creates an undulating sound band rather than a melodic pattern. Perhaps an appropriate question at this point is: If there is no melodic content, what is the subject of the work? Voussoirs like numerous other orchestral works of the late Twentieth Century utilizes color, textures, and sound densities as its subject matter to create an atmospheric environment in a current practice whose roots reach back through Boulez's Le Marteau sans maître, Varèse's Ionisation, Ives' 4th of July, Debussy's La Mer, to Wagner's "Prelude" to Das Rheingold and before. In Voussoirs a new "non-melodic" order of sonic events has supplanted the traditional role of melodic function.

The current interest in instrumental color and orchestration as a vital musical element can be traced back directly through Debussy and Ravel to Wagner and Berlioz. Although instrumental color and, in a sense, instrumentation has always existed, either specified in a written score as it has been since Giovanni Gabrielli's Sacra Symphoniae (1597), or decided by the composer or performer on a practical or aesthetic basis in the ages before notated instrumentation, the emphasis on its role as an important musical element has greatly changed over the years. Berlioz is usually considered the first real master of colorful orchestrational effects, and, in fact, was often severely criticized by his contemporaries for allegedly attempting to mask the formal and structural weaknesses of his scores with lavish instrumental color and

exotic textures. Because of his important experiments and contributions to the development of orchestration and orchestral effects, most avant-garde composers today regard Berlioz as the great grandfather of the Twentieth Century avant-garde and one of the high priests of the experimental music tradition in the West.

Wagner too did a great deal toward changing the concept of instrumental color and orchestration to its present importance. The "Prelude" to Das Rhinegold, for instance, is a wonderful example of his tremendous skill in using instrumental color. The undulating Eb triad that is repeated for 136 bars creates the effect of the Rhine's flowing waters by relying almost totally on instrumental color and changing textures. The result is truly one of the most novel and colorful preludes ever conceived for an opera and, curiously, it is similar in concept to many of the most recent avant-garde works by a new generation of New York composers, Steve Reich, Terry Riley and Phillip Glass, who use a similar drone-like quality of stationary harmony.

The first real mentor of the Twentieth Century avant-garde was Claude Debussy. In his mature works he carried the Romantic fascination with instrumental color to an unprecedented extreme. Rarely had instrumental color and elaborate orchestration enjoyed such importance. Debussy's influence was international and since his time similar preoccupation with color has become a critical musical consideration for all composers. The works of Stravinsky, the use of Klangfarbenmelodie in the Schoenberg school, Varèse's exploitation of

color, the invention of new instruments such as the Theremin and Ondes Martenot, the unconventional use of existing instruments such as the piano in Henry Cowell's Aeolian Harp (1923) or Banshee (1925) or John Cage's Sonatas and Interludes for Prepared Piano in the late 1940's all illustrate the increasing interest in not only new sound sources, but the exploitation of new coloristic effects as musical ends in themselves.

In 1948 Pierre Schaffer and Pierre Henry at Paris's Radio Diffusion Francaise gave a historic broadcast of taped sound collages of train whistles and other concrete material. The idea of utilizing non-musical sources for the production of a new kind of music ushered in the era of electronic music. By the early 1950's both New York and Cologne had established studios, and the interest soon spread over the rest of Europe and America. The important aspect of these studios on the use of instrumental color is apparent in some of the early works for electronic tape and orchestra such as Deserts (1954) by Varèse. The virtually wide open realm of possibilities made available through synthesized sound has had a visible effect on composers familiar with this new source. Composers like Boulez and Stockhausen, Kagel and Koenig, Penderecki and Ligeti, David Behrman and George Crumb have each elevated the element of color to one of the most important aspects of the composition. Voussoirs too relies heavily on orchestration, varying sound textures, and chains of coloristic effects. Voussoirs, like Ligeti's Atmospheres (1961), Apparition, (1958-59), or Ramifications (1969), Stockhausen's Gruppen (1958),

Kagel's Heterophonie (1962), or Penderecki's De Natura Sonoris (1966), is a work which concentrates on the coloristic element as one of the most important and primary aspects of the composition.

The use of electronic tape with a live ensemble stems from practice begun shortly after the advent of electronic music in the early 1950's. Some of the first works for orchestra and electronic tape were Otto Luening's and Vladimir Ussachevsky's combined efforts to produce Rhapsodic Variations for Tape Recorder and Orchestra, and at the same time, Bruno Maderna's early work in this area at the Nord Deutsche Rundfunk in Cologne. Deserts (1954) of Edgar Varèse is another of these early attempts at combining electronic tape and live ensemble.

Most of these early works and even most of the more recent works up through Morton Subotnick's Lamination I (1970) use primarily straight electronically produced sounds for the tape portion of the work. One of the most influential works on my creation of the electronic tapes for Voussoirs, however, was Earle Brown's new work, Times Five for electronic tape and five performers. In this interesting composition Earle Brown utilizes prerecorded instrumental sounds which are gradually filtered and transformed into purely electronic sounds. A similar concept is used in the organization of the electronic tapes in Voussoirs.

Voussoirs, like every other work of art, is the manifestation of many influences, subtle and overt, which have gestated in me as a composer, and were ultimately formulated and realized in the writing of this new work.

CHAPTER II

THE COMPOSITIONAL PROCEDURES

Media

Voussoirs is scored for an orchestra which includes: 4 Flutes (each doubles on Piccolo), 3 Oboes, 4 Clarinets, 4 Bassoons (4th doubles on Contra), 5 Horns, 4 Trumpets, 3 Trombones, 1 Tuba, 7 Percussionists (a detailed description of the individual instruments needed is provides with the score), 2 Tape Recorders and Operators, 12 First Violins, 10 Second Violins, 8 Violas, 8 Cellos, 7 String Basses, and Conductor. The arrangement of the orchestra is described in Chapter III and in the forward of the orchestral score.

Electronic Tapes

There are two different electronic tapes which are to be used simultaneously on two different stereo, half-track tape recorders. The tapes (called Tape 1 and Tape 2 in the orchestral score) were produced in The Ohio State University Sound Laboratory, the Bregman Electronic Studio, Hanover, New Hampshire, and the University of New Hampshire Electronic Studio, Durham, New Hampshire. Each tape contains both pure electronic

sound which was produced on the Moog Series III Synthesizer, Synthi 100, Buchla Series 200, ARP Series 2500 Modular Electronic Synthesizer, and prerecorded orchestral sounds from the November 1, 1971 rehearsal of the Ohio State University Symphony rehearsing the first movement of Voussoirs with the composer conducting. The instrumental sounds taken from the recording session are either presented in the score as unaltered orchestral sound which have been spliced and edited to form a collage, or presented in the score as basically orchestral material which has been processed by means of filters, voltage-controlled oscillators, or speed changes.

The following flow charts in Figure 4 illustrate the patchings used in producing each of the two electronic tapes.

Figure 4

Flow Charts for the Electronic Tapes

Abbreviations:

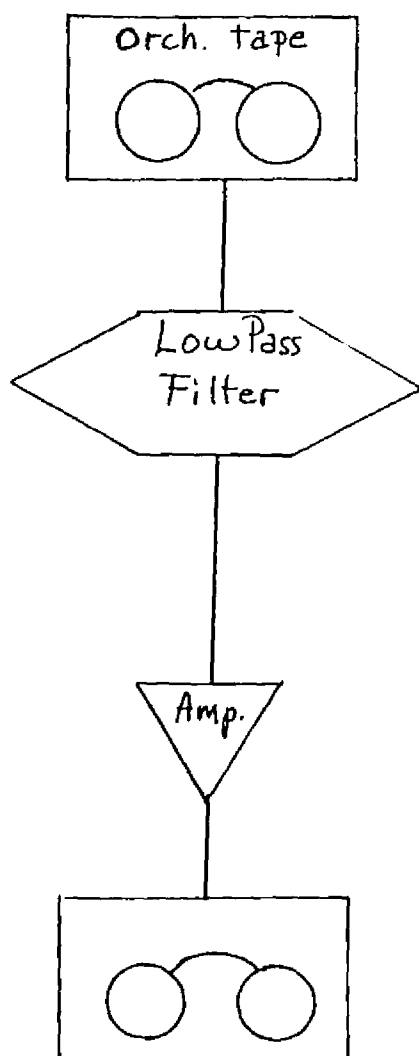
Osc = Oscillator
 VCO = Voltage Controlled Oscillator
 VCA = Voltage Controlled Amplifier
 Env. Gen. = Envelope Generator
 Loc. Con. = Location Control
 K.B. = Key Board
 W.N. = White Noise
 P.N. = Pink Noise
 R.V.G. = Random Voltage Generator

First Movement

Tape No. 1

Cue 1

ARP 2500

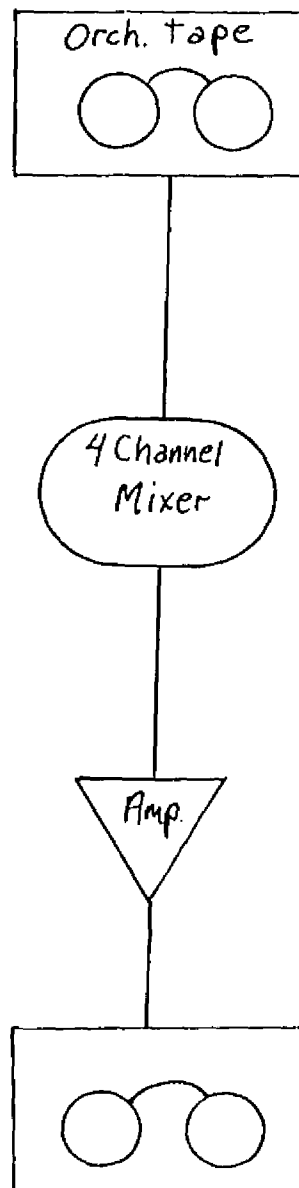


First Movement

Tape No. 1

Cue 2

Moog Series 3

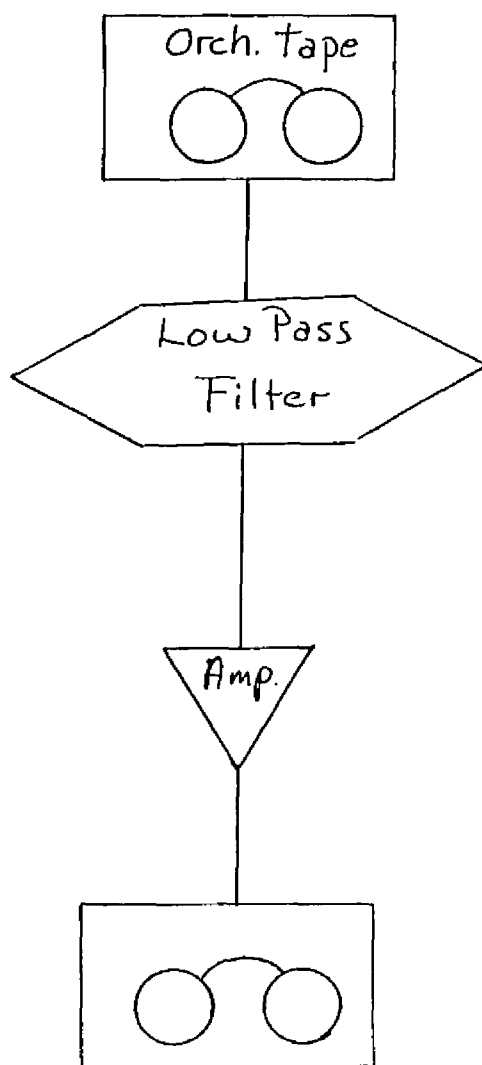


First Movement

Tape No. 1

Cue 3

Moog Series 3

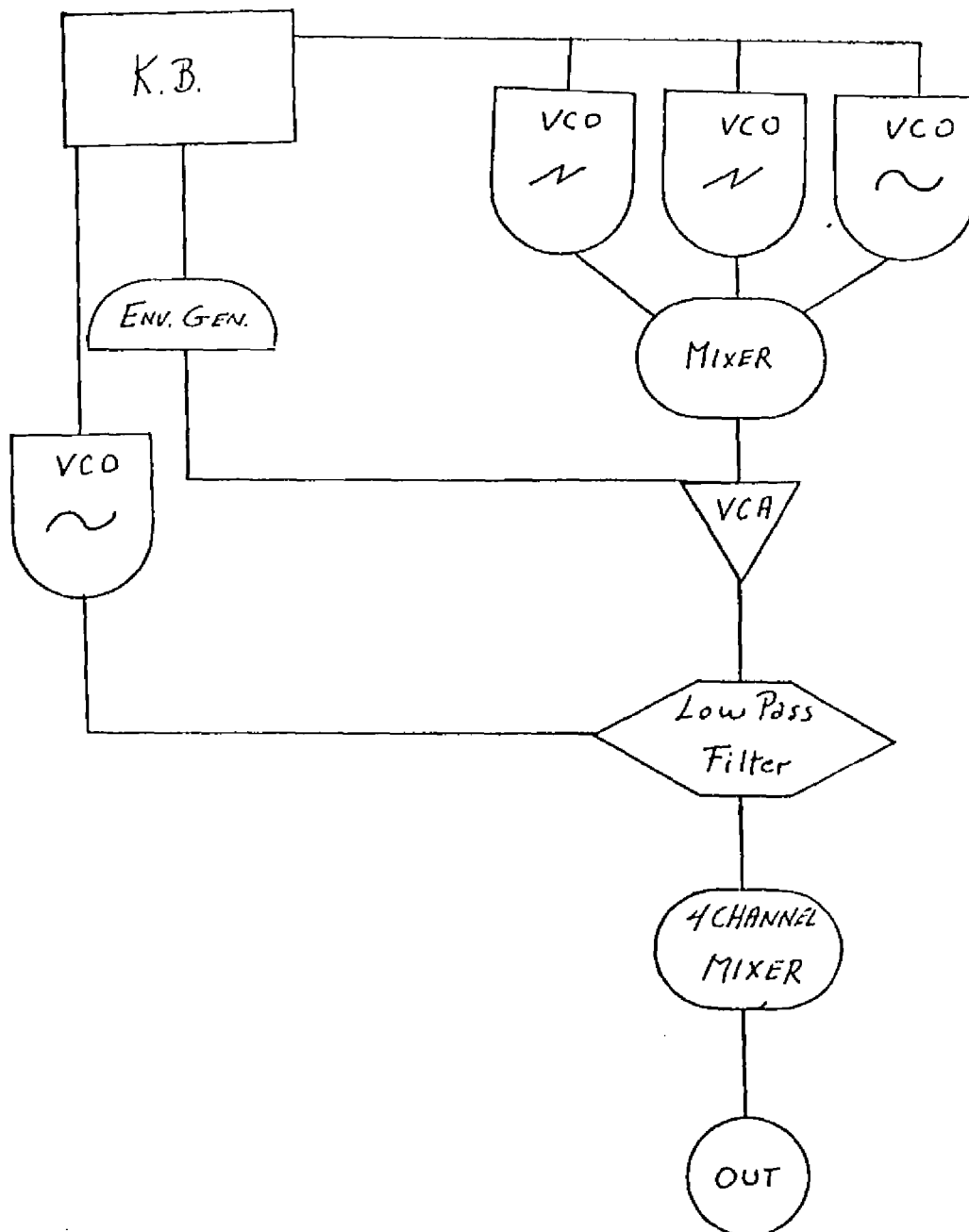


First Movement

Tape No. 1

Cue 4 ("Interlude")

Moog Series 3

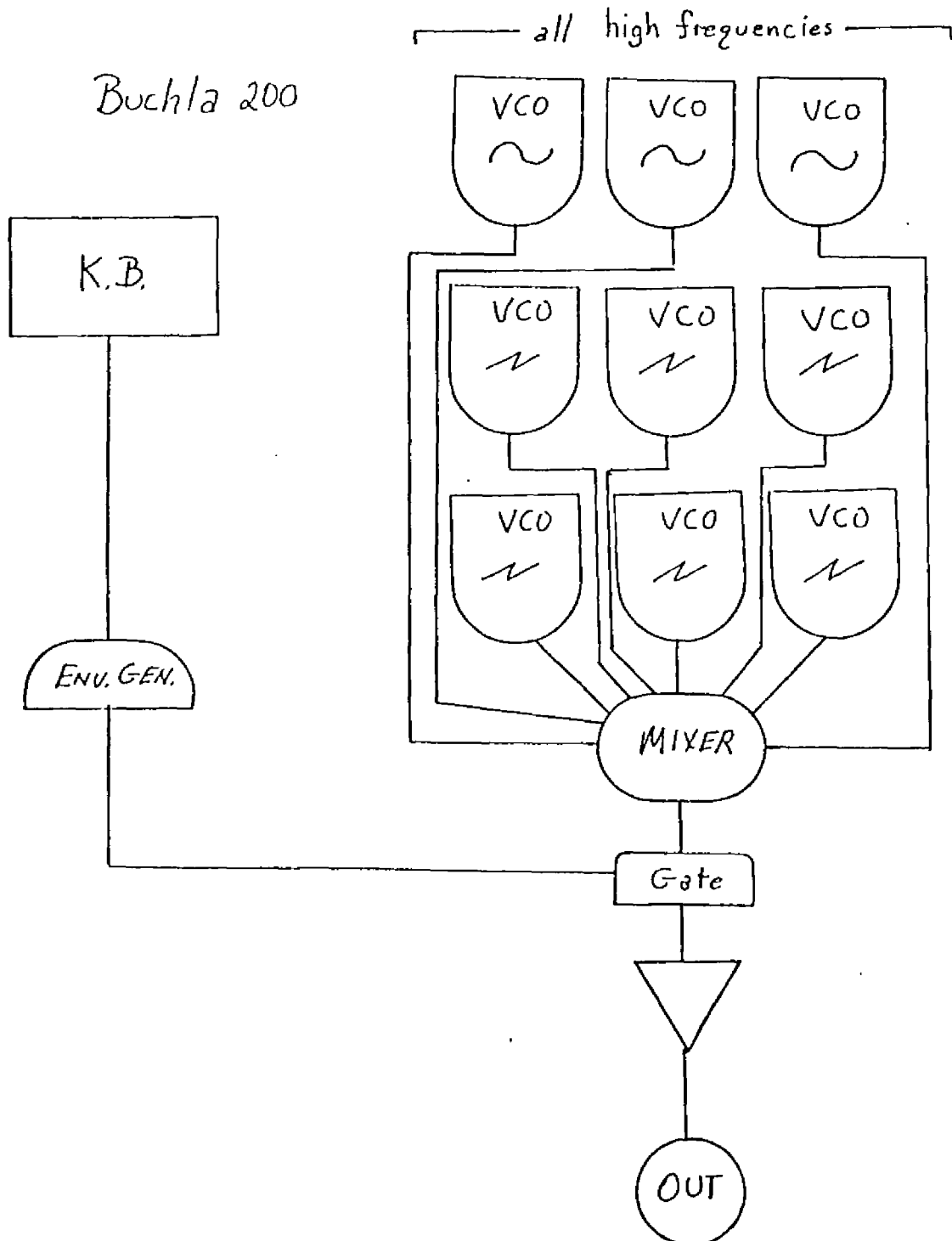


First Movement

Tape No. 2

Cue 1

Buchla 200

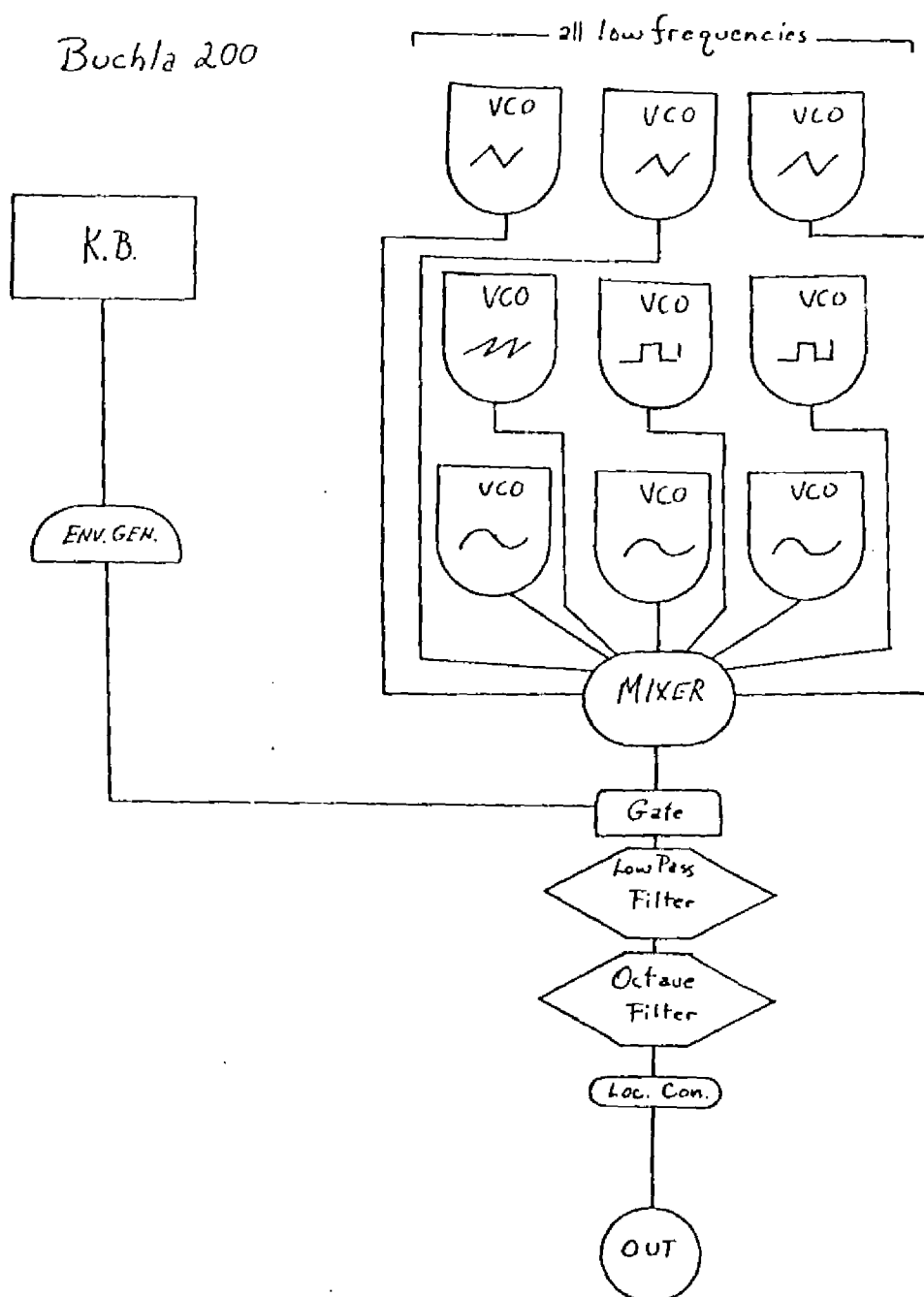


First Movement

Tape No. 2

Cue 2

Buchla 200

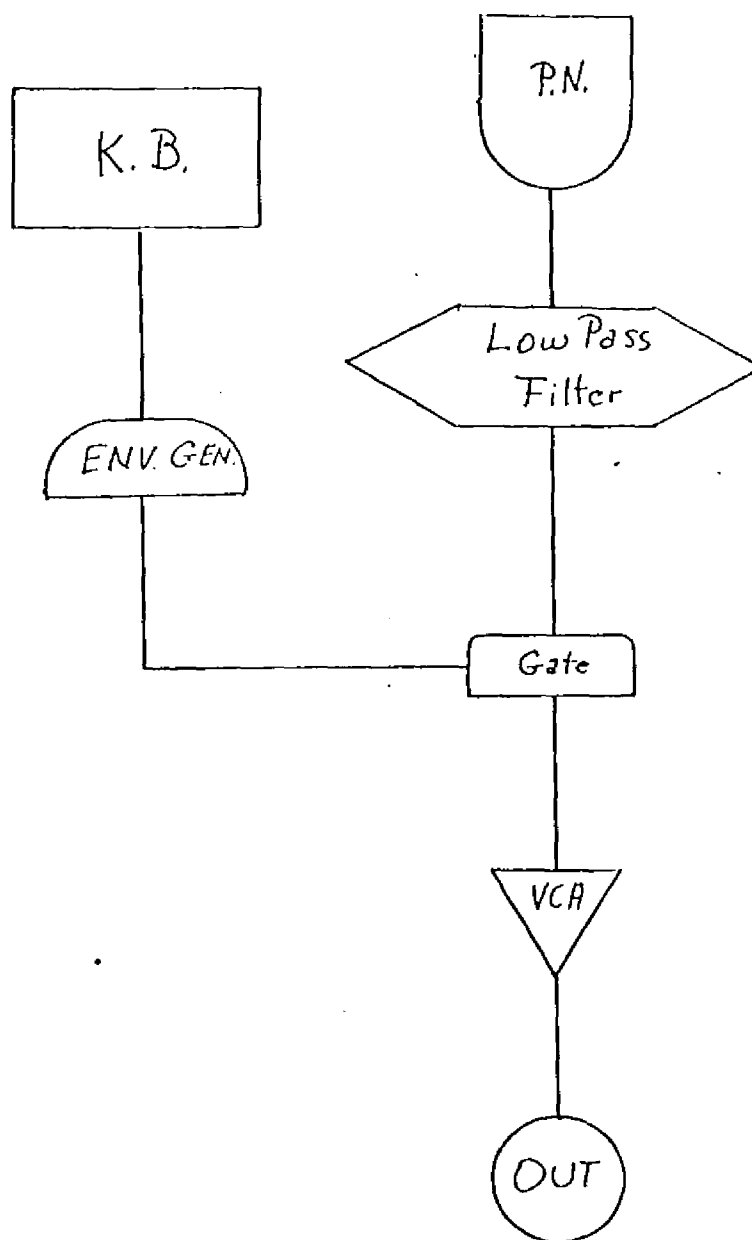


First Movement

Tape No. 2

Cue 3

ARP 2500

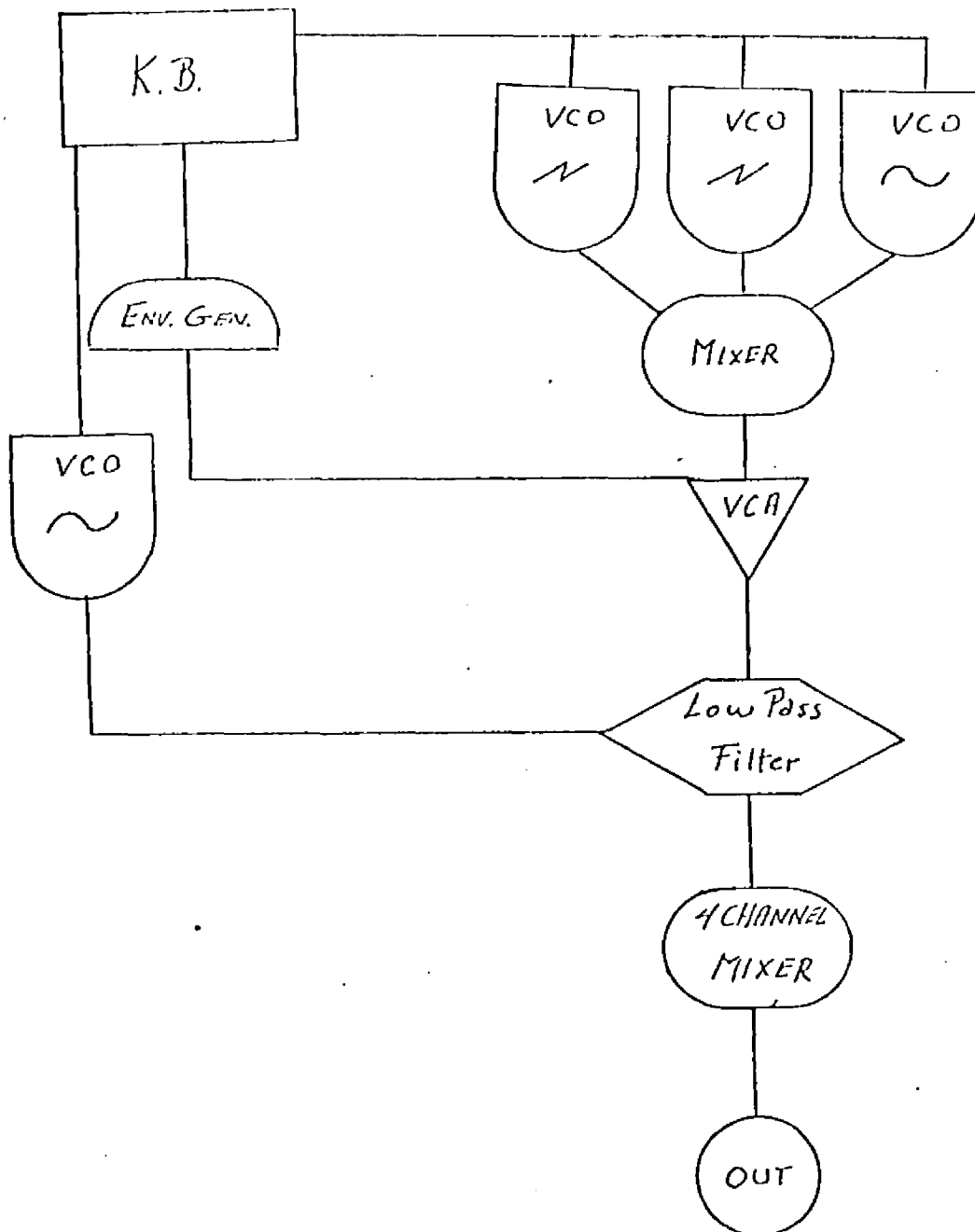


First Movement

Tape No. 2

Cue ("Interlude")

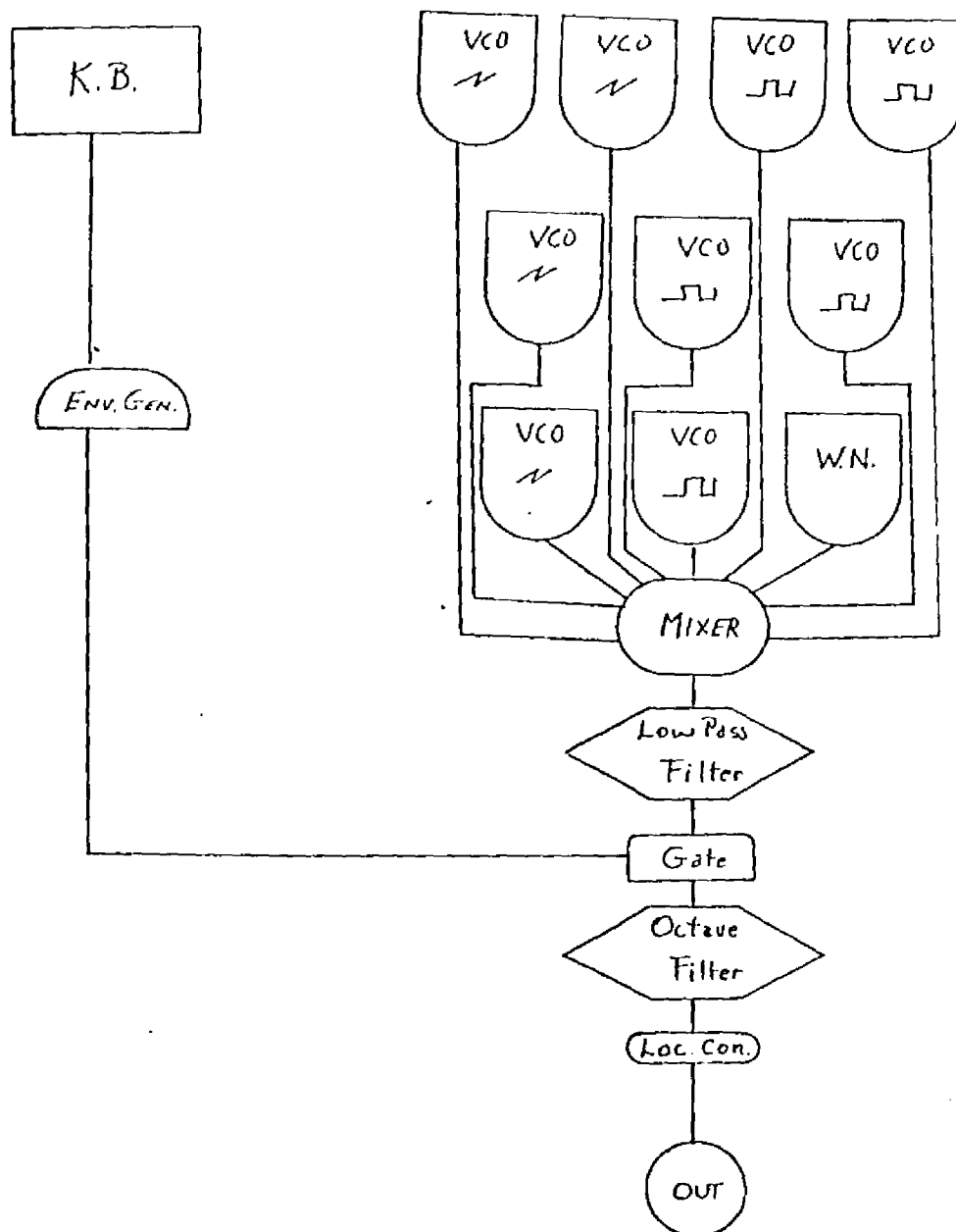
Moog Series 3



Second Movement

Tape No. 1

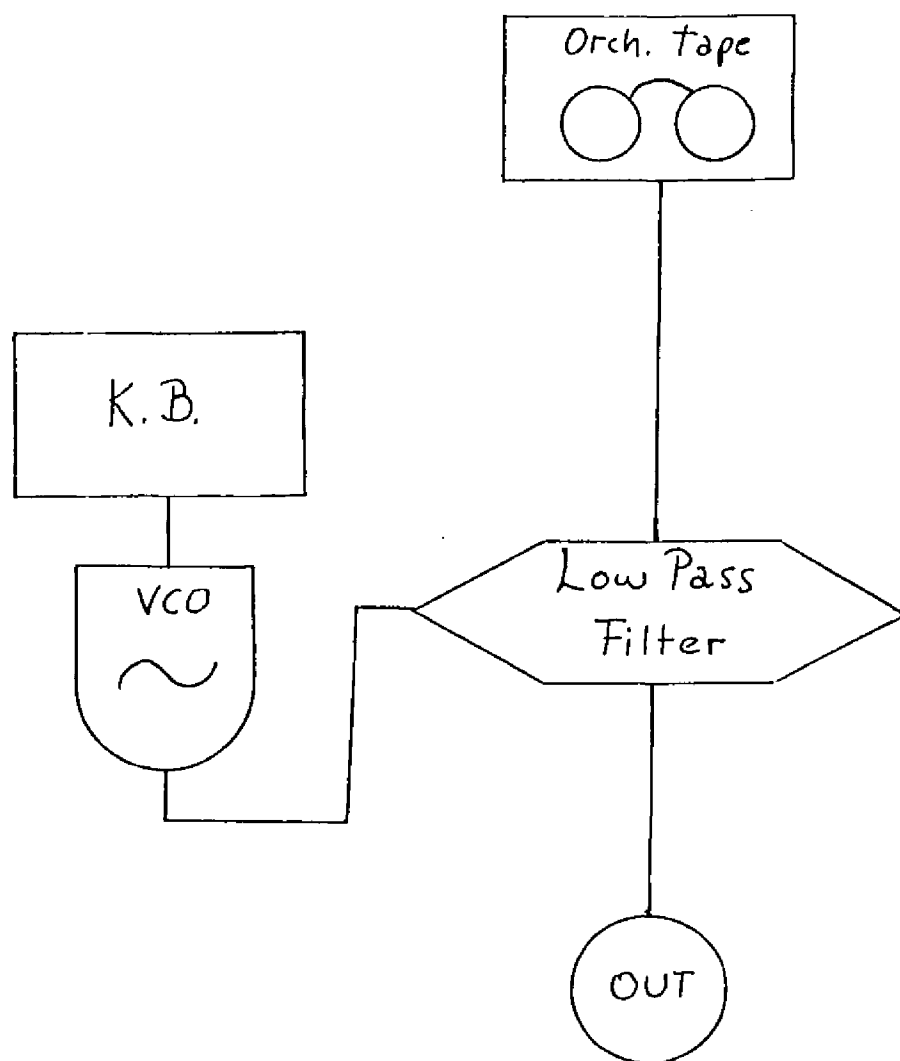
Cue 1

Buchla 200

Second Movement

Tape No. 1

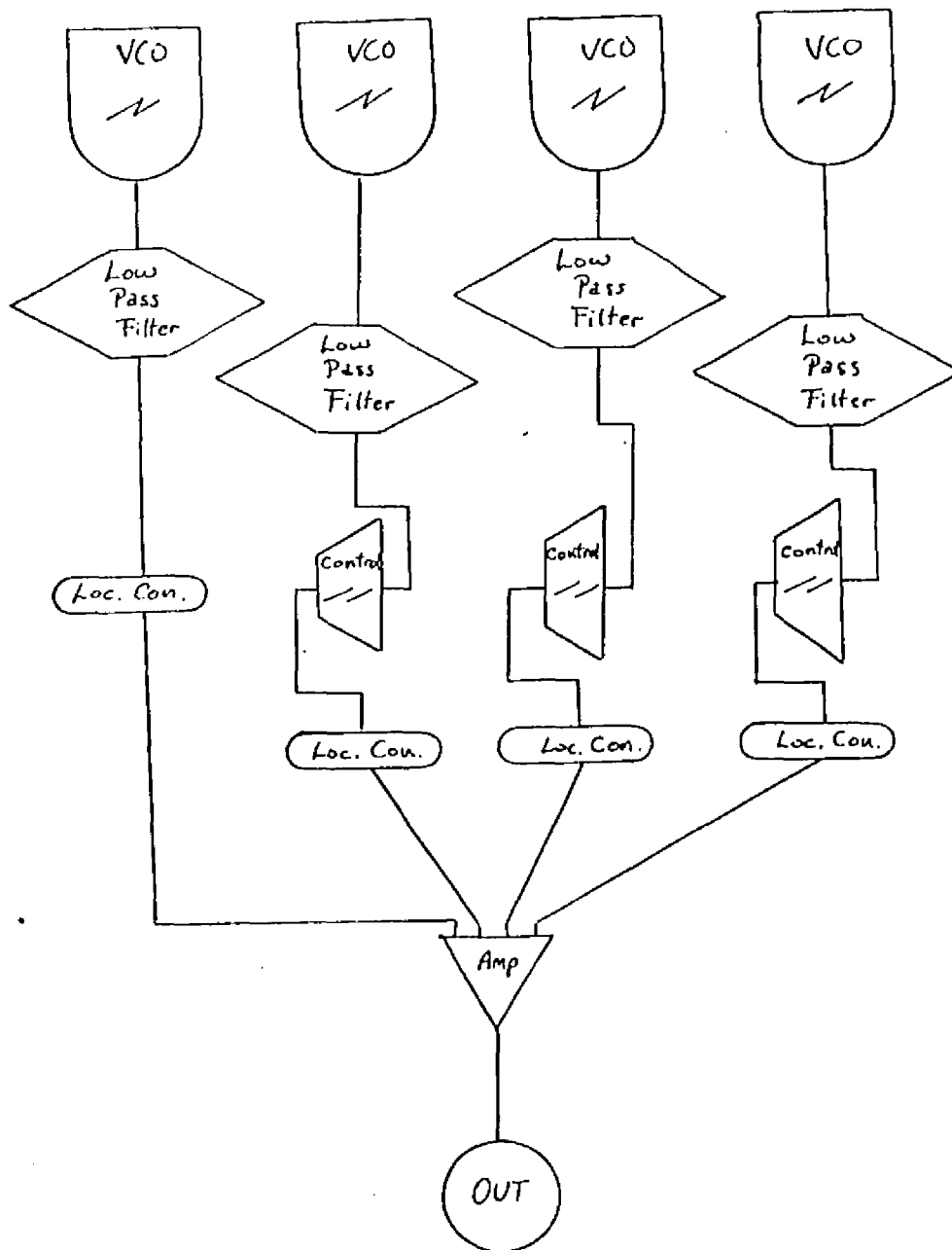
Cue 2

Moog Series 3

Second Movement

Tape No. 2

Cue 1

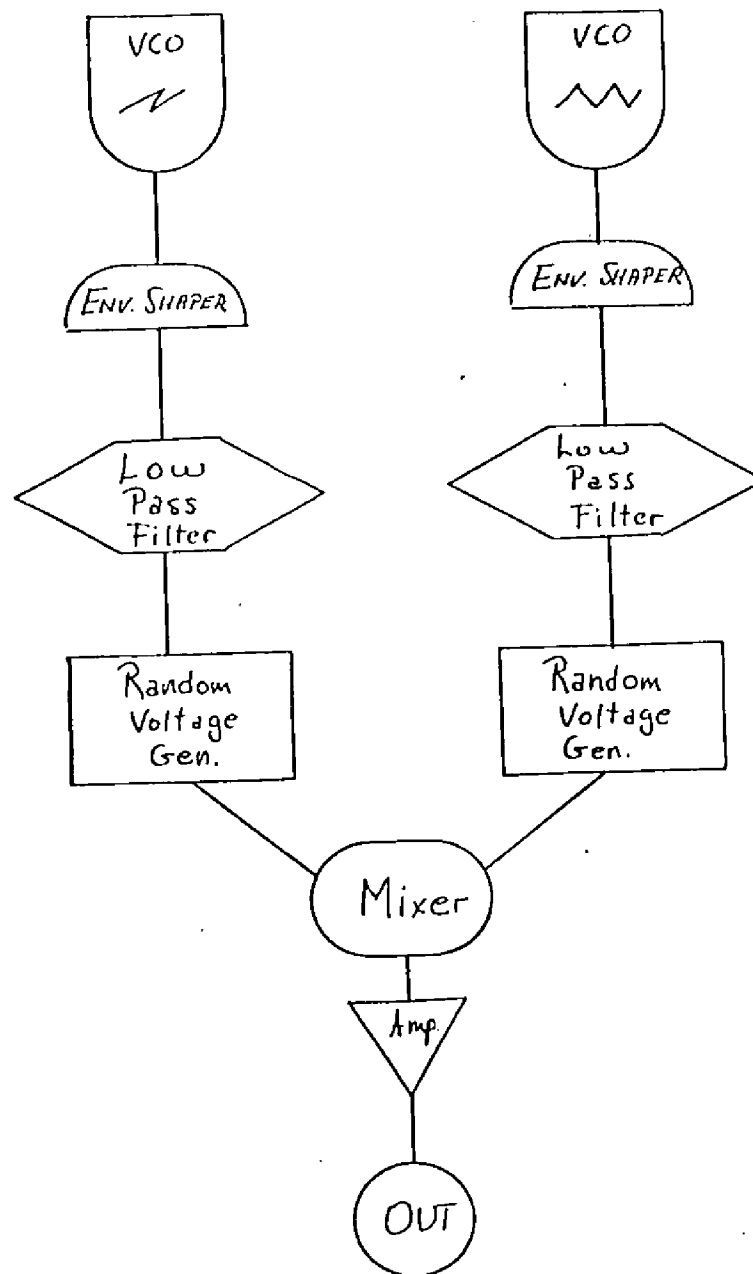
Synthi 100

Second Movement

Tape No. 2

Cue 2

Synthi 100

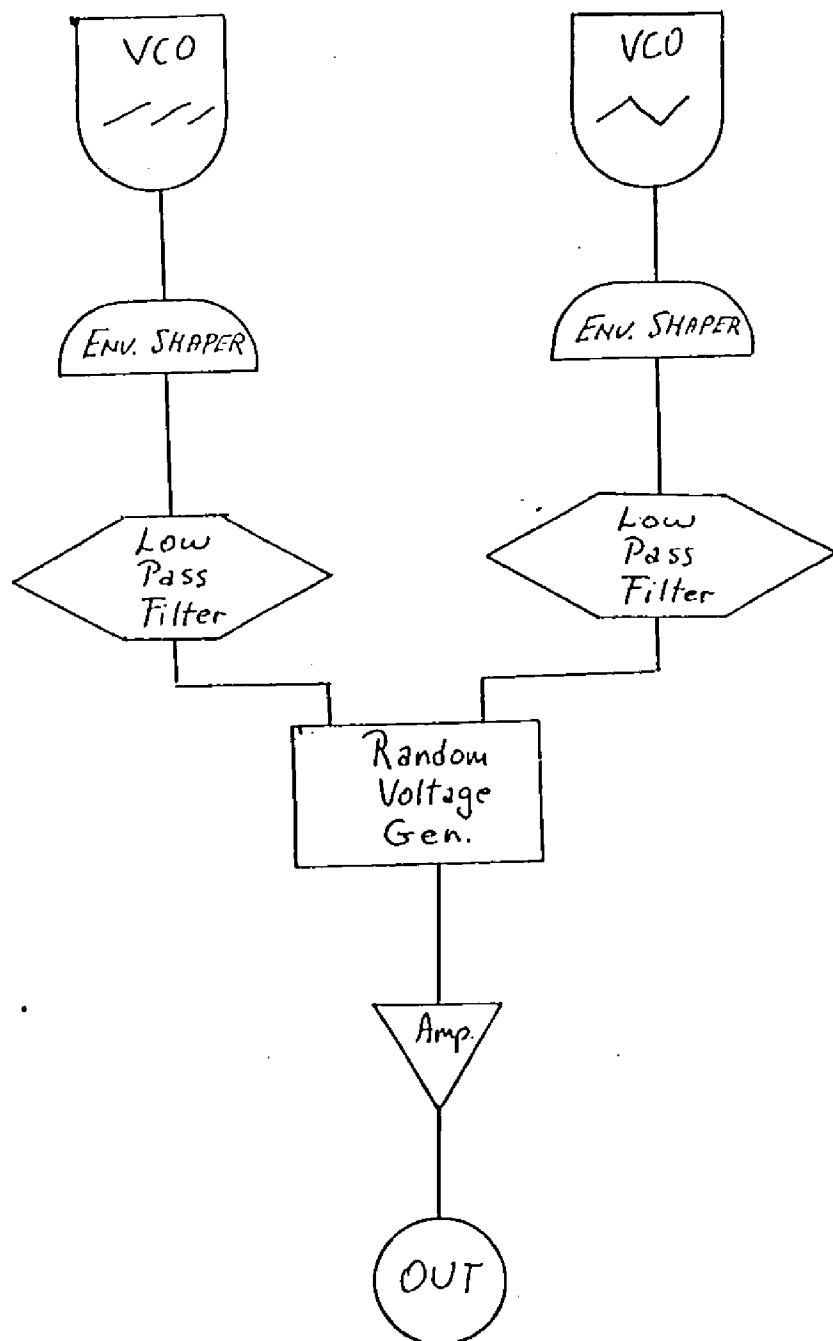


Second Movement

Tape No. 2

Cue 3

Synthi 100

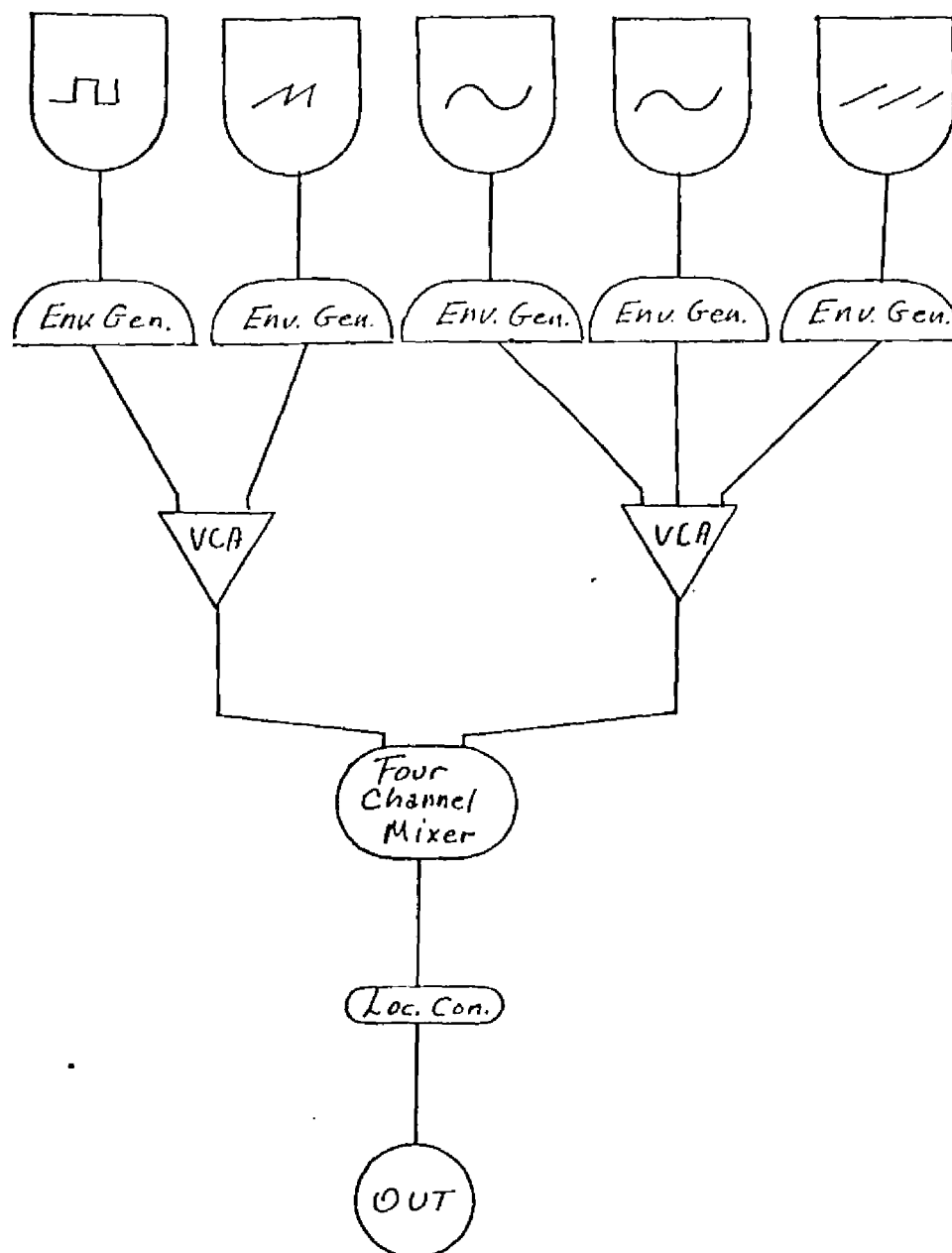


Second Movement

Tape No. 2

Cue 4

Moog Series 3



Meter, Rhythm, and Tempo

Nearly all of Voussoirs is scored in 4/4 meter except for two bars of 2/4 (bars 27 and 140 in the first movement) and the final section of the second movement (from bar 70 on) which is written ϕ or alla breve.

The reason for this simple signature and for the use of bar lines is solely for the synchronization of the various individual parts, and as an aid to temporal articulation.

The rhythmic patterns scored in Voussoirs were either long sustained notes which neutralize the feeling of pulse and tempo, or patterns which were so numerous and diverse as to create the feeling of movement without resorting to traditional metric pulsation.

The tempos to be used are marked with metronome markings at the beginning of each section.

Form

"Voussoir" is a French word which is used in the English language to mean "wedge" as in the vaulting of an arch. This term was applied to my composition because of the "wedges" of clusters that form the basis of the work. It is the use of these "wedges of sound" that provide the fundamental unifying element for the entire work.

Voussoirs was first conceived in terms of geometric shapes and patterns. I first drew a graphic score of the geometric shapes I wanted to create in terms of sound and arranged them in a balanced order. From the graph I began to realize the various shapes and designs in musical sound and space. The following designs are the graphic scores I used for the realization of Voussoirs (Figures 5 and 6).

Figure 5: First Movement

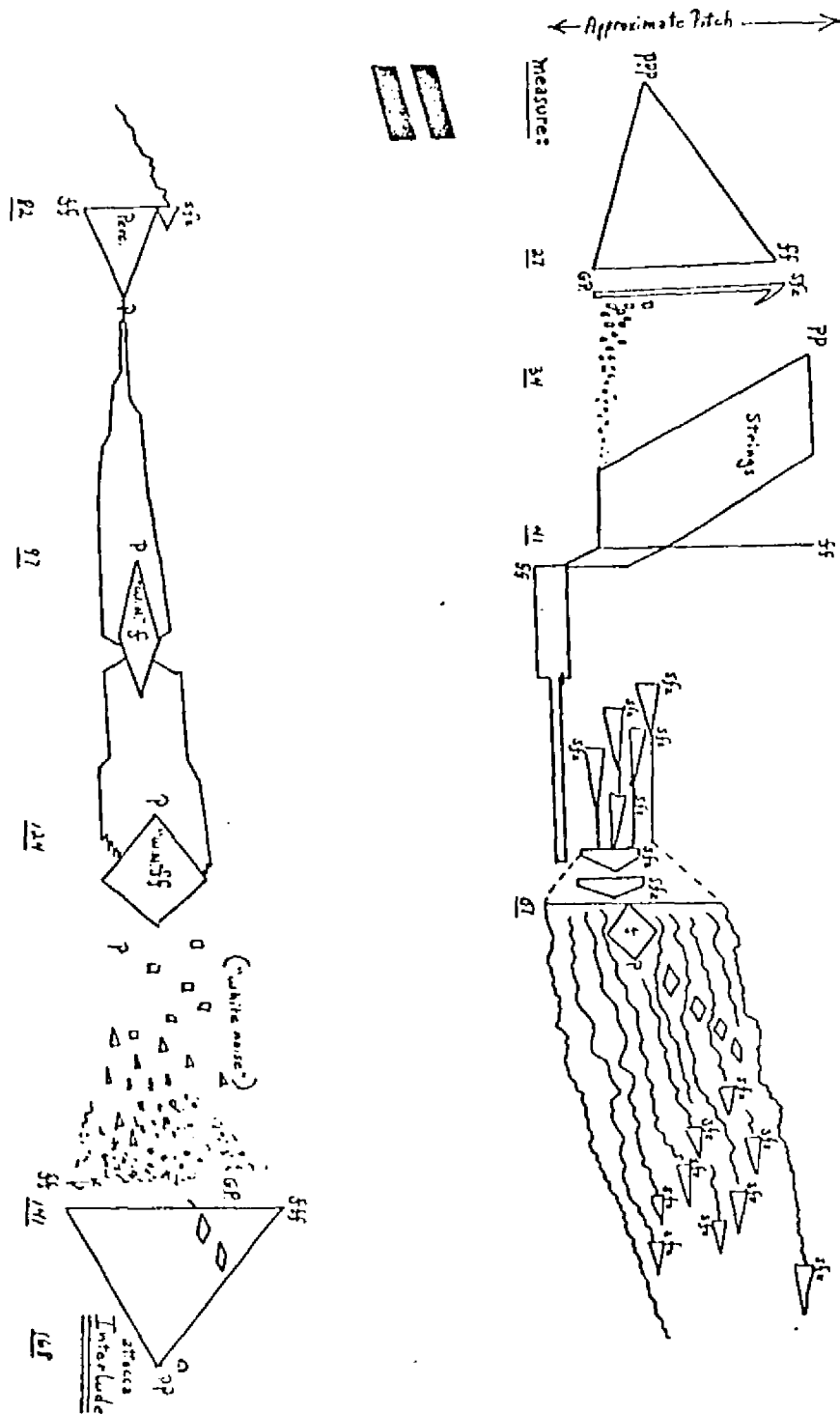
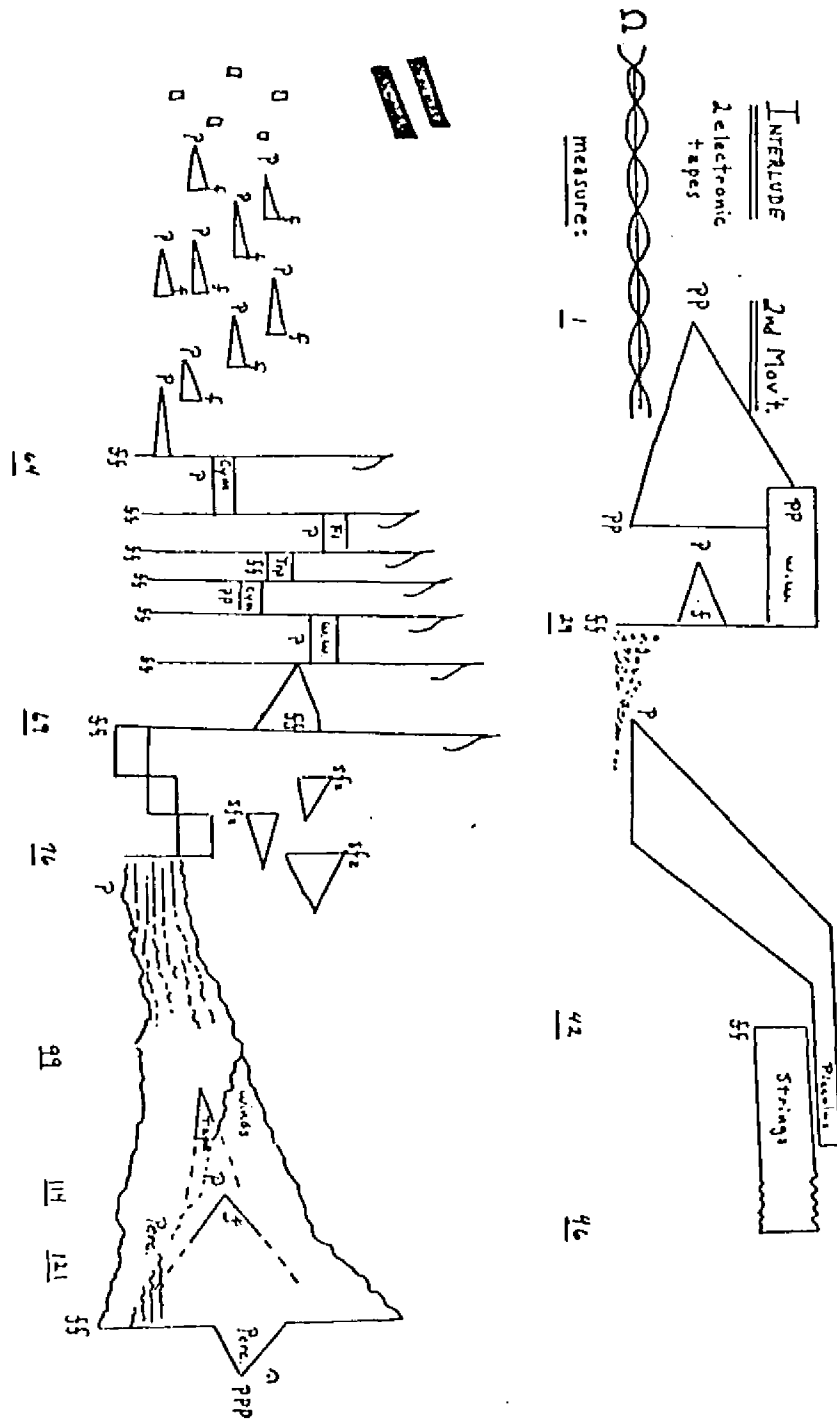


Figure 6: Second Movement



As is obvious from the graphic illustrations in Figures 5 and 6, the wedges of sound occur in both movements very prominently. The largest wedges are the two that begin and end each movement (measures 1-29 and 146-168 in the first movement, and measures 1-21 and 82-133 in the second movement). On a smaller scale are the numerous other kinds of sonic wedges which are found in either a form of amplitude (crescendos and decrescendos) or in some kind of terracing or piling up of sounds into three, four, five, or more note-groups. The use and permutations of these various forms of sonic wedges throughout both movements provides a basic level of formal coherence and unification.

Unity between the two movements is achieved by means of a cyclic process which I prefer to think of as "allusion." As briefly mentioned in Chapter I, the second movement was so constructed as to allude to many of the techniques and sonorities found in the first. Many of the geometric forms realized in the first movement are inverted or coloristically changed to provide the illusion of new constructional material. From the graphic illustrations in Figures 5 and 6, this process is immediately visible. From the sonorities produced in a live performance situation this similarity is not so obvious.

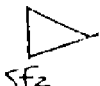
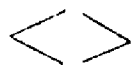
The sonic wedges used in Voussoirs are constructed and used in numerous ways. The basic parameters, however, are pitch and dynamic intensity, though instrumental color is often an important element in the larger wedge forms. The following is a list of the sections which employ these

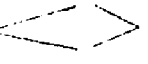
various wedge-shaped sounds and a brief description of their shapes, use, and construction.


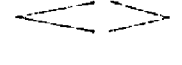
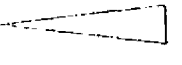
First Movement


(1) The large opening wedge (measures 1-29) is built using both parameters -- a widening pitch range, and an increasing dynamic intensity. The basic wedge-shape is formed by means of moving lines which begin very slowly and gradually crawl toward extreme ranges and a very loud climax at measure 29. The color changes from the very thin string sound sul ponticello at the beginning to an extremely thick full orchestral sound at the climax (measure 29). Within the large shape are smaller wedges in the form of crescendos and decrescendos at bars 10 through 15 in which various dissonant harmonies rise out of the thick string texture.

(2) At Measures 34-47 a different shape of wedge is created. This one is shaped in the form of a parallelogram which begins very high in the strings and gradually descends very softly to the Double Basses. This wedge is based on pitches and makes no use of dynamic change.

(3) From measures 48 through 146 the wedges are much smaller in pitch range and increasingly shorter in duration. In measures 52 through 86 there are generally dynamic wedges of sound in the form of  or . The section as a

whole, however, is constructed as a large pitch wedge-shape of  beginning at measure 52 and ending just before the percussion section at measure 87.

(4) Measures 87 through 145 are primarily a percussive treatment of wedge forms. The beginning of the section at bar 87 is a dynamic wedge  with full percussion. The next wedge is in the form of "white noise" or wind players blowing through their instruments (measures 102-105). At this point the shape of the "white noise" wedge is  and treated dynamically from soft to loud and back to soft. At measure 108 through 129 the 4 cymbals form a terraced wedge by their gradual addition to the texture of the bass drum and the stroking of the strings on the inside of the piano. Measures 129 through 130 are a dynamic wedge, , of "white noise." This leads to the last wedge of "white noise" and percussion which both are combined beginning at measure 131. The final wedge (measures 131 through 145) is constructed from both dynamics and terraced pitches. The wedge begins as a fragmented series of "white noises" triggering the percussion's crescendos which become increasingly closer events, ultimately turning into a massive crescendo of "white noise" and percussion from measures 142 through 145.

(5) The large wedge then ends the first movement (measures 146-168) also utilizes the parameters of pitch and terraced dynamics. Its basic shape is  and the dynamics are

extremely loud to very soft. It is the longest of the wedges and gradually fades into the electronic tapes which are used for the "Interlude." The decrescendo from the very loud dynamic markings at measure 146 to the end is accomplished by two means: (1) instruments dropping out in a terraced manner, and (2) a gradual decrescendo of those instruments left playing.


Within this large wedge are smaller wedges as in the large wedge at the beginning of the movement. These two smaller wedges are dynamic wedges in the shape of crescendos and decrescendos. As in the beginning wedge, these smaller wedges live various dissonant harmonies above the dynamics of the thick orchestral texture and then fade.

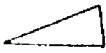
Interlude

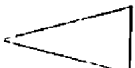
The "Interlude" does not make use of wedge-shaped forms. Instead, it consists of electronically generated sound sources which are controlled by sine waves to provide a contrasting setting and a transition to the second movement. The patchings are contained in Figure 4. The basic sound is a transformation of orchestral timbres to purely electronic sound generation in the course of an approximately two minute quad-rasonic event.

Second Movement

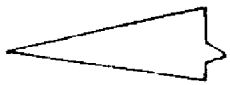
(1) The large opening wedge (measures 1-28) is somewhat similar in construction to the opening wedge of the first movement. The basic shape, timbre, and dynamics, however, are, in several ways, different. The contrasting shapes for the opening wedges in the two movements are clearly seen in the graphic illustrations in Figures 5 and 6. The roles of the winds and strings are reversed in the two opening sections. Where the first movement used strings, the second movement uses winds. The dynamics too are modified in the second movement. The first movement utilized a long crescendo to fortissimo. The second movement remains soft through the analogous section to the first movement, but reaches a fortissimo in the brass (measures 24-28). The widening pitch range is similar in concept but accomplished by different means in the second movement. The crawling melodic lines used in the first movement are replaced in the second movement by glissandos in the strings. There are also no smaller wedges within the larger wedge in the second movement as there had been in the analogous section of the first movement.

(2) The parallelogram used in the first movement is inverted in the second movement at measures 32-46 and takes on the shape . In contrast to its use in the first movement, the parallelogram increases in dynamic intensity and integrates the timbres of all the orchestral instruments.

(3) In measures 51-64 the shapes are  but are generally contrasted with those in the first movement by being executed on combinations of instruments with varying timbres.

(4) In the improvisational event that takes place at measure 69 both a dynamic and terraced pitch wedge-shape are used. The event is divided into three sections of 15 seconds each. The First Violins begin softly with pizzicato which then increases in dynamic intensity and by the number of instrumentalists executing the event. An electronic tape also adds dynamic intensity and terraced bands of sound in a wedge-shape of  .

(5) The wedges used between measures 70 and 82 are dynamic wedges in the form of crescendos and decrescendos as in the first movement.

(6) The final wedge (measures 82-133) is the largest of the wedges in either movement and is in the form of  . This large form is comprised of four subforms of wedges which result in the climax of the work. The patching of four-note clusters by means of sforzando attacks in the winds from measure 70 build a band of sound at measure 87 from \underline{E}^3 to approximately small e. The static clusters at measure 82 begin moving as in the wedge at the beginning of the first movement and the wedge at the beginning of the second movement. At

measure 99 the winds enter in the terraced shape of a parallelogram followed at 101 by the electronic tapes Nos. 1 and 2 which begin the long crescendo to the end. At 194 the strings begin playing with tremelando which starts in the middle with the Violas and spreads throughout the string section. The percussion is finally added in a terraced fashion starting at measure 122. The work reaches a tremendous climax at measure 131. The final wedge is the percussion morendo after the cut-off of the full orchestra's fortissimo at measure 131. The last large wedge (measures 82-133) utilizes most of the constructive devices found in the previous sections of the two movements.

The durations of the two movements bear another type of relationship. The first movement is approximately 9 minutes long while the second movement is only a little over half that length. Most of the events found in the first movement are truncated in the later movement not only by actually having fewer measures, but also by generally appearing in faster tempos. The opening section of the first movement, for example, is marked $\text{♩} = 58$ and the beginning wedge of sound is 29 measures long. The analogous event at the beginning of the second movement is marked $\text{♩} = 84$ and is only 21 bars long. The section in the first movement beginning at measure 48 in which sforzando attacks build a dense band of sound is 39 measures long at $\text{♩} = 60$ and its complementary event in the second

movement (measures 46 through 64) is, by contrast, 28 bars long at $\text{♩} = 84$. The final wedge form in the second movement, however, is much longer than any of those found in the first movement and is intended to balance the generally shorter events of the second movement with the longer events of the first.

The use of instrumental colors and sonorities also differs from movement to movement. There is an attempt on my part as the composer to have generally maintained similar instrumental colors for the wedges in the first movement and contrasting, diverse timbres for the construction of the wedges in the second movement. In the first movement the wedges, therefore, are usually found in instruments of the same families or instruments with similar timbres. The opening wedge, for example, is primarily a string sound though the winds support the middle register from measure 10 through 15. The parallelogram created at measures 35 through 47 is also straight string sonorities. The small wedges used in the section from measure 48 to 87 are generally executed by instruments of the same family and the four-note clusters are all sustained in the string family. The percussion section beginning at measure 87 and continuing through 144 is another example of the use of similar timbral sounds in the first movement. Within the large section devoted to the percussion section, there are some rather subtle timbral changes. The first part of the section (from measure 87 to

104) is basically percussion instruments played with metal beaters. The section after "white noise" (104 to 129) is performed with the same instruments except played with soft mallets and beaters. The last part of the percussion section (129 to 145) is a crescendo which uses the elements of "white noise" in combination with the timbres of percussion instruments played with both soft mallets and metal beaters. The final large wedge which begins at measure 146 also maintains a certain uniformity of color keeping the dissonant harmonies that rise out of the thick texture, first, in the brass (measures 146-149), and then in the woodwinds (measures 150-152). The strings remain alone until the end when the electronic tapes begin the "Interlude."

The second movement integrates the various instrumental timbres to a much greater degree. The parallelogram at measure 32 through 46, for instance, combines the colors of both strings and winds in their lowest and highest ranges. The sforzandos after letter F utilize diverse wind combinations in contrast to the use of the same wind colors at similar points in the first movement. The use of sustained string sounds at the section beginning at measure 70 adds the human voice humming to the pitches of the various strings, and the final section beginning at measure 82 integrates the various families of instruments with the electronic sounds from the two tape recorders.

The use of electronic tapes also is contrasted between the two movements. In the first movement the electronic tapes were primarily prerecorded orchestral sounds which, when they are altered, are altered by means of filters and voltage-controlled oscillators. The "Interlude" between the two movements provides a transition of timbres from the generally prerecorded sounds of the first movement to the predominantly electronically generated sounds of the second movement.

One final process in organizing this work was the use and treatment of the clustered harmonies. Clusters were used to not only destroy any sense of key relationship, but to create a different environment in which one's attention could be focused on the sonic events as unique entities in and of themselves.

In the first movement the clusters are primarily built in half-steps with occasional pentatonic (measures 63-65 in the Horns), or dissonant choral harmonies emerging from the thick textures (as in measures 10 through 15 or 146 through 152). The second movement, however, contains not only the dissonant half-step clusters, but generally uses a wider spectrum of clustered sounds. The half-step clusters are frequently used at climactic points as in measures 45-48 and often preceded by the static harmonies of what might be called a "pandiatonic" cluster -- all the "white notes" on the keyboard as in the parallelogram (measures 32 to 39). The electronic tapes also

provide more variety of diverse sonorities and coincidental harmonies than are to be found in the first movement.

Voussoirs, in spite of the seemingly apparent relationships, like many of the avant-garde compositions written in this era, creates the general feeling of a very loose structure with a very free chain of events orbiting about it. Some different parameters of unification have been explored in an attempt to replace the traditional use of melody and key relationships with more subtle, evasive relationships. Voussoirs however, in the final analysis, is to be experienced as a purely sonic event of shifting sound bands and changing timbres in which sound and color are to be enjoyed for their own sake.

CHAPTER III

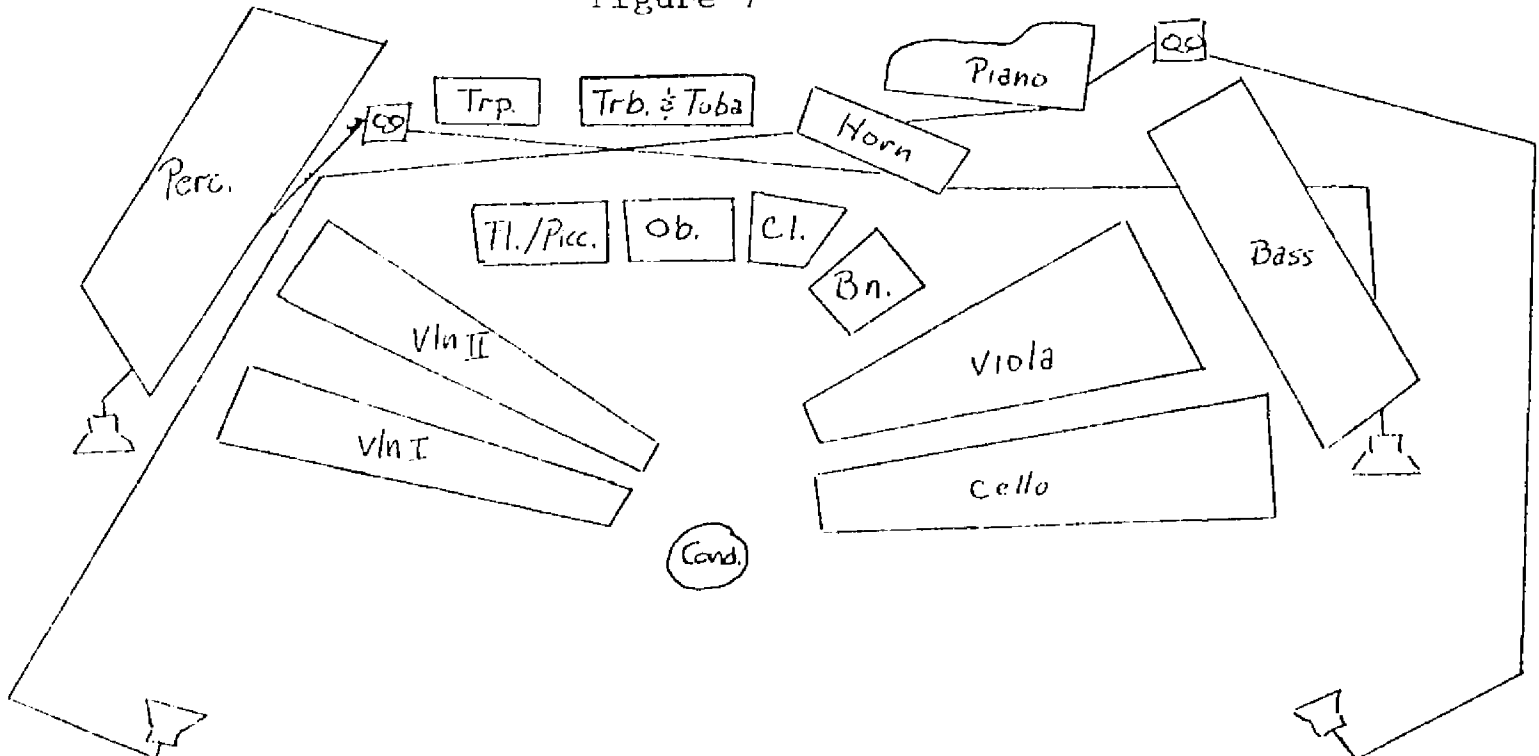
Performance Notes

Perhaps the most basic and most difficult problem facing any composer who is interested in having his orchestral works performed is finding both a conductor and an orchestra who are (1) willing to work on a new score, and, if that, (2) are willing to give the new work the proper rehearsal time necessary for both the conductor and orchestra to learn the music properly. Once these major hurdles are past, the other details are relatively inconsequential.

Seating Arrangement

The arrangement of the orchestra is to be as follows:

Figure 7



Conductor

The only accents to be given are those written in the score.

It is the conductor's responsibility to balance the levels of the two tape recorders with the orchestra sound. The tape recorders and operators are to be treated as instruments of the orchestra and cued at entrances and for dynamic changes.

For the "Interlude" tapes the conductor must either (1) have a stop watch for determining the beginning of the second movement, or (2) memorize the point on the tape at which the second movement begins.

The section at H in the second movement is divided into three 15 second sections. The instrumentalists repeat the event as many times as possible in the 15 seconds and at the conductor's cues of 1, 2, and 3 fingers, they jump from wherever they are in the event to the next event without break.

In the sections after A C and H in the second movement, the instrumentalists are given graphic symbols. These symbols indicate improvising in the manner of the preceding standard notation. There is a series of coordinative cues beginning after letter I. The conductor at this point indicates to the orchestra which cue by using fingers one to five. The first set of coordinative cues is one through five and the second set is one through three. These cues are to keep the

orchestra together and to establish faster rhythmic models from which to improvise. Care should be taken as the rhythmic figures become faster not to emphasize the down beat at the measure line.

Tape Recorders


The tape recorder operators are to be musicians and have a good knowledge and skill in using the tape equipment. The tapes are stored tail out which means the reel is to be placed on the right side of the machine and wound onto the left before playback performance.


The dynamic levels on the tapes can and must be adjusted not only to balance the orchestral sound as any other instrument of the orchestra would, but also to "play" the dynamic levels indicated in the electronic tape parts. It is therefore necessary that the tape recorder operators be familiar with their instruments and have clear visibility of the conductor.

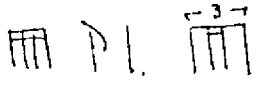
In practically all the events on both reels, there is more tape than is needed during the performance. Therefore, the operator is to simply stop the recorder at the appropriate point in the score by turning the gain down first and then stopping the reel. The reel must then be moved forward to the next cue leader tape.


Notation

Most of the notation is standard notation, but there are a few points where graphic notation was necessary to produce the desired effects. Some explanation would perhaps be helpful:

(1) The notation:  indicates to continue the figures, rhythmic and melodic, in a similar manner to the standard notation immediately preceding the graphics. The graphic pitches are approximate to the area of the staff. The use of 9va----- would then indicate continuing the improvisation up an octave higher using similar, but not necessarily the same figures of the standard notation immediately preceding the graphic section.

(2) The notation:  used between A and B in the string parts on the second movement, indicates a slow glissando at the approximate pitch levels of the curvey lines. The changing of strings should be as smooth as possible.

(3) The notation:  indicates the exact rhythmic figure that is to be used, but not the exact pitches. The pitches can be chosen by the performer, but should be taken from the approximate area of the stem's end.

(4) The notation: W.N.  indicates "white noise" which is produced on the wind instruments by blowing air through the horn. Care should be taken at those points in the first movement to keep the sound continuous throughout the event,

if necessary, by staggering breathing, or having nearby players not involved imitate the "white noise" sound with their mouths.

(5) The "humming" that takes place after H in the second movement is to be done audibly on the note the string player is sustaining. It can and must be reattacked as imperceptibly as possible to maintain a continuous sound. Transposition of pitches from the individual string notes will be necessary, so a transposition should be chosen that will be comfortable and produce the best quality. The humming stops when the sustained notes change to the moving lines.

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