

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53
 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105
 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126
 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146
 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164
 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183
 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204
 205 206 207 208 209 210

A perc.

Alto sax

Tpt

Tnb

St. Bass

Cello

Fl.

5 6 7 11

30

210

$\frac{17}{7} \frac{120}{50}$

$\frac{15}{11} \frac{165}{55}$

$\frac{28}{7} \frac{196}{56}$
 $\frac{29}{7} \frac{203}{1463}$

11 $\frac{210}{210}$
7 $\frac{210}{22}$ 210
6 $\frac{210}{11}$ 330
18 385
51
48
30 462
20
31

$\frac{2}{11} \frac{202}{99}$

$\frac{11}{11}$

$\frac{11}{11} \frac{12}{12}$

$\frac{15}{7} \frac{105}{35}$
 $\frac{1}{7} \frac{112}{42}$

2
107

19
7

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 +

41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 +

81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 +

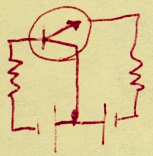
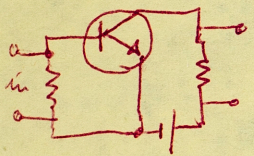
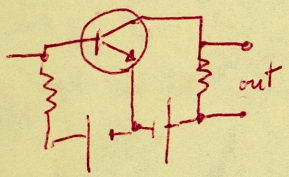
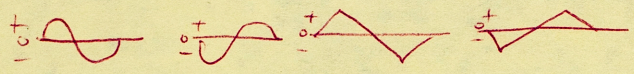
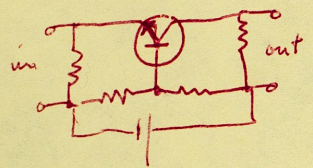
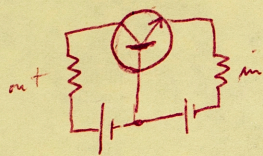
126 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 +

66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 200 +

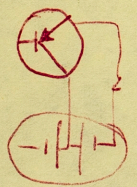
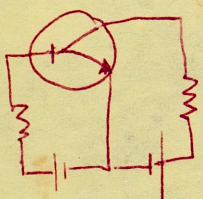
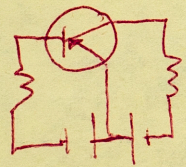
201 2 3 4 5 6 7 8 9 210 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 +

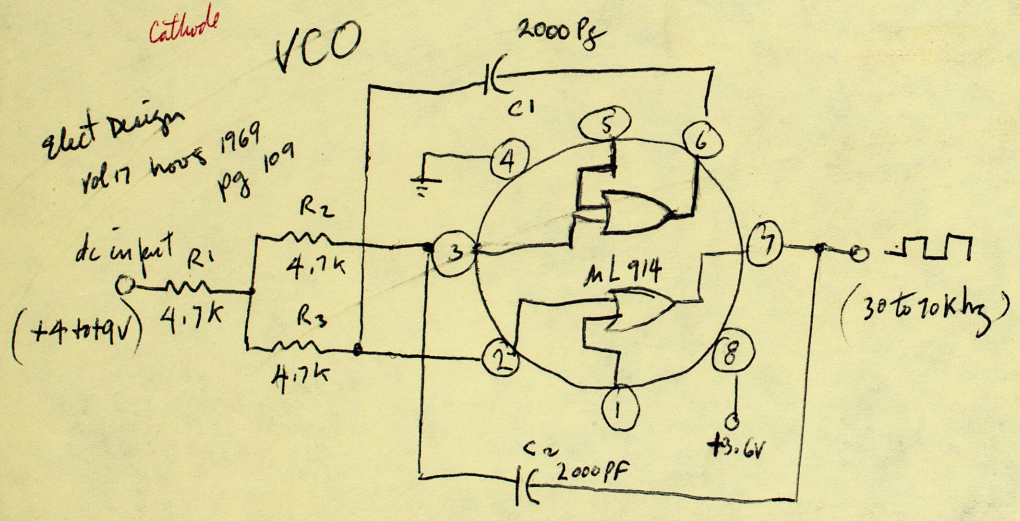
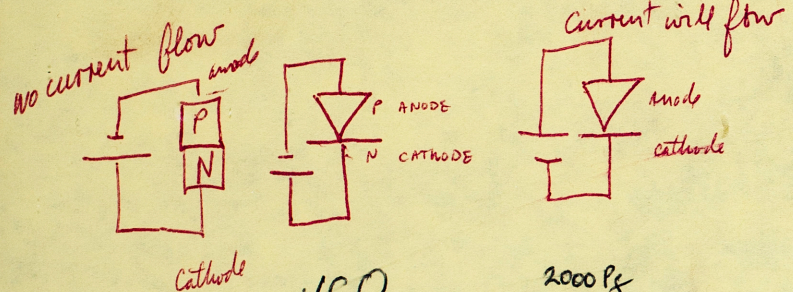
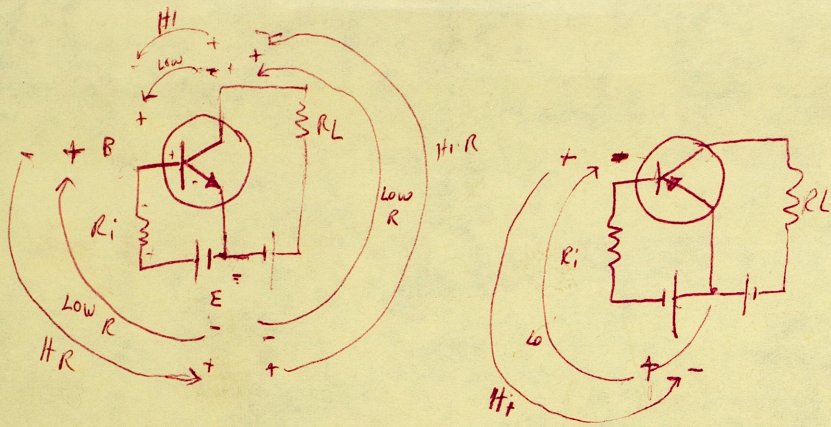
31

Common base input - then output -
 Common emitter " - " " " +
 Common collector " - " " " -



||

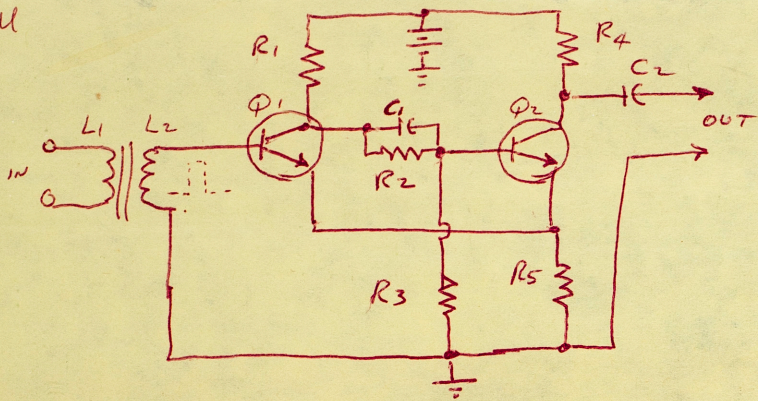




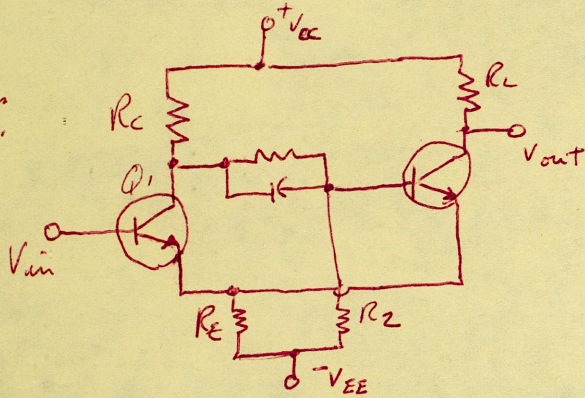
elect design
vol 17 Nov 1969
pg 109

Schmitt Trigger

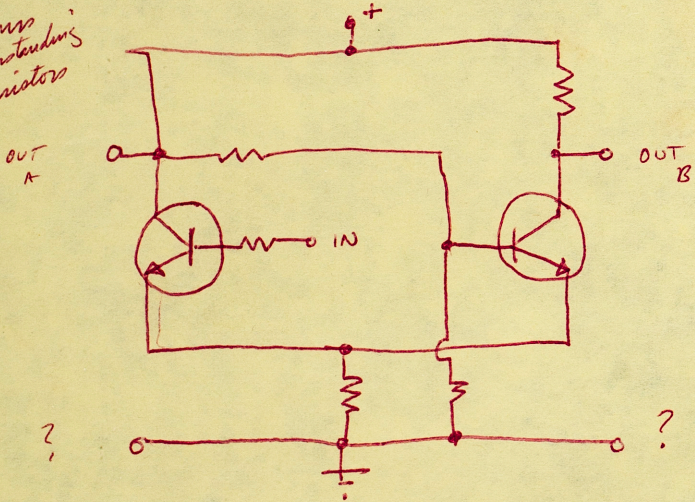
Model



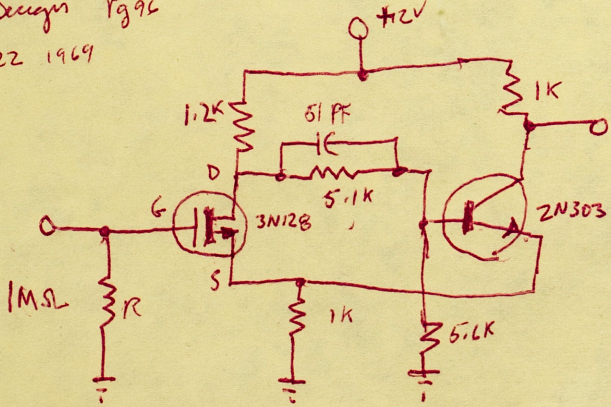
Sams Dict.



Sams Understanding Transistors

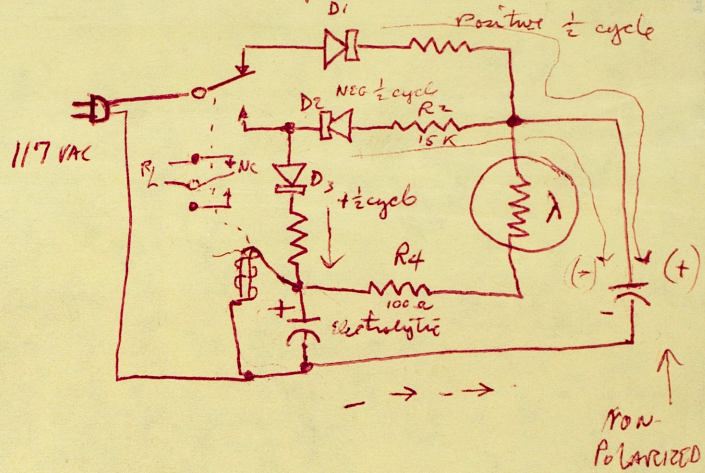


Elect. Design Pg 96
Nov 22 1969



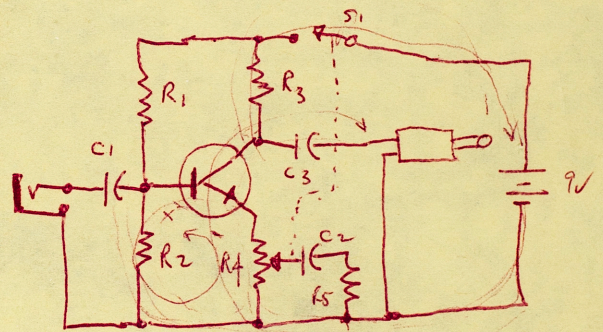
Bistable Photo sensitive switch

Pop Elect Dec 1969



Treble booster

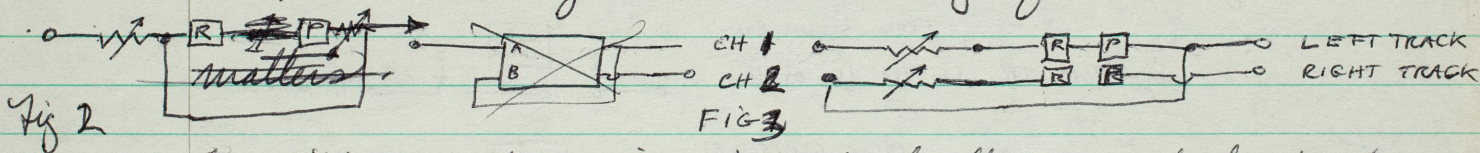
anode + cathode



The tape recorder has become an instrument for some of my compositions.

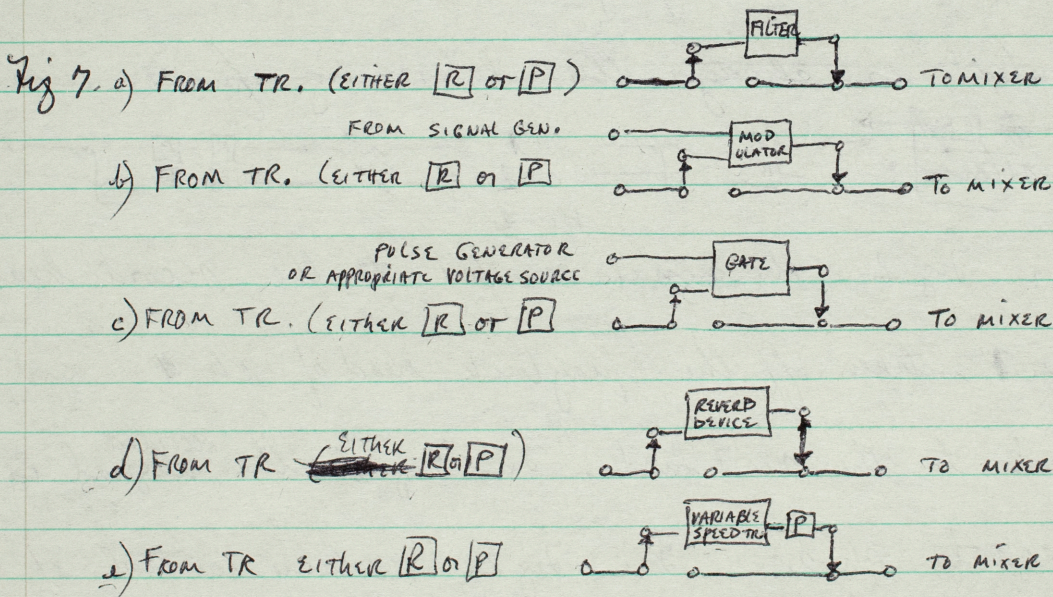
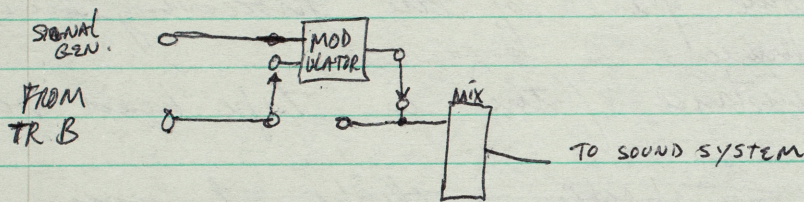
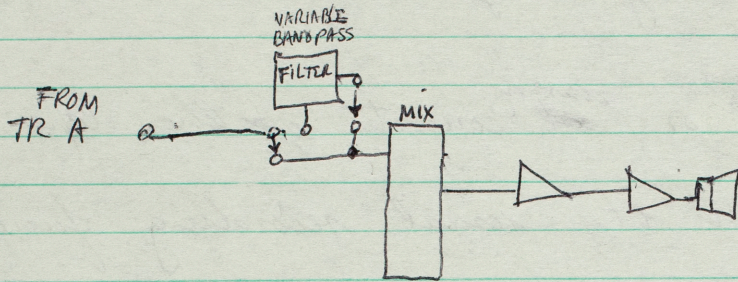
Whether in the studio or ~~at~~ ^{during} concerts of the tape recorder has uses beyond its usual recording function and can become part of the processing ensemble in Electronic Music.

A common instance of this is tape head reverb, which to some people is cliché, however the context is always the determining factor in such



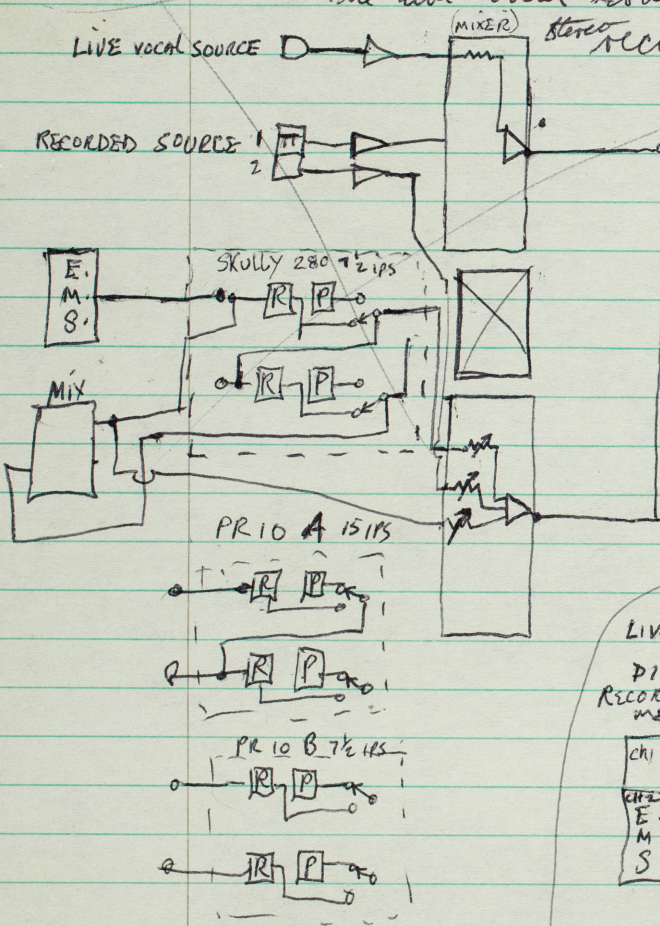
In Fig 2 the signal is fed to the record head of ch. 1 taken off the playback head of ch. 1 and fed back to the record head. In Fig 3 the ^{recorded} signal is fed back to ch. 2. In Fig 2, volume control of feedback is possible but monitoring of the effect is sacrificed. In fig 3, volume control of the feedback is available on ch 2 from 0-max without effecting the monitoring of either channel. As much or as little reverberation as ~~possible~~ ^{desired} is possible.

Gate
Filter
Modulator

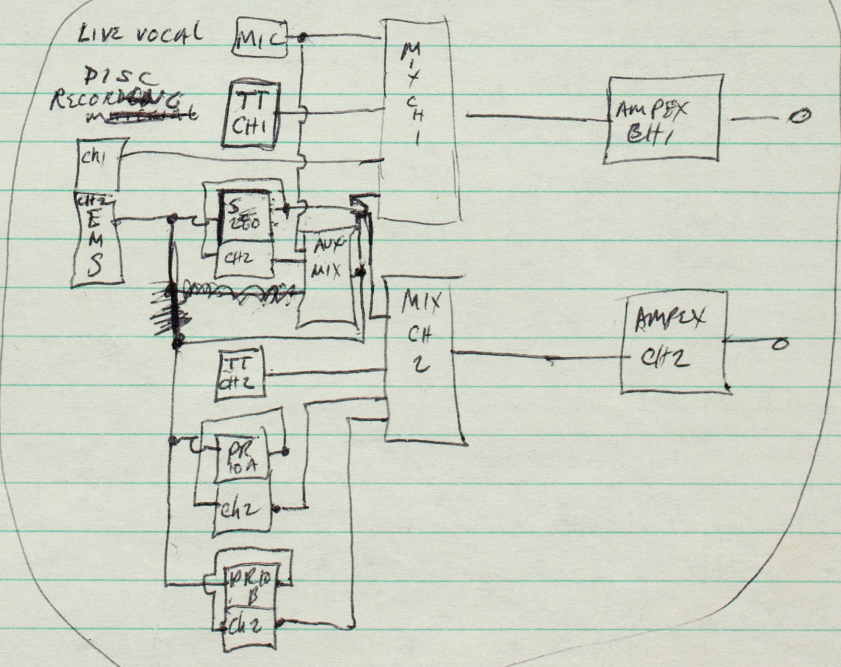


Take a walk. Make no sound. The bottoms of my feet were like ears.

Because
 Fig. 10 a Every delay line was controlled by a mixer pot and as much or little feedback as desired was introduced and each delay could be treated as a separate source. The live vocal source was fed to ch 1 and 2. The recorded source was stereo recorded source was stereo fed to ch 1 and 2 respectively. Sources from the Buchla Modular E.M.S. were fed directly to ch 1 mixer, and ch 2 sources were delayed through the Studley 280. Ch 1 of 280 went directly to Ch 2 mixer and Ch 2 Studley went to aux mixer. The output of Aux Mix went to ch 1 mix, to ch 1 of Studley 280 and to PR 10 delay lines. PR 10s were also fed from the EMS.

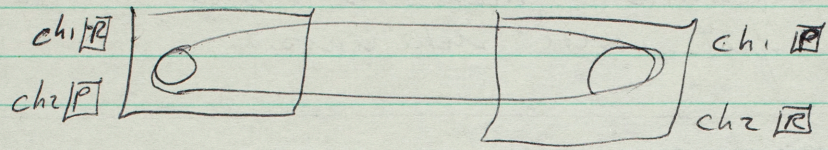


AMPEX 350 AT 7 1/2 IPS
 SKULLY 280
 PR 10 A 15 IPS
 PR 10 B 7 1/2 IPS



7.5
 8
 60.0

By sending delay lines to various processing devices, a large number of variations could occur.



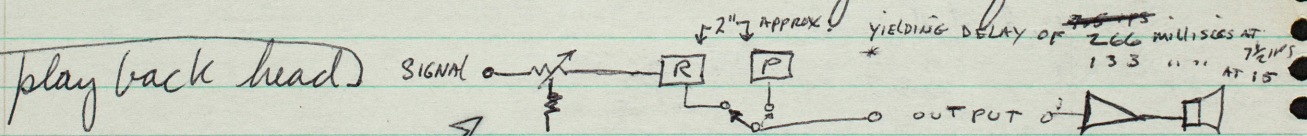
Tape head reverb and Tape Delay Systems
For Studio and live Electronic Music

- 1 Beautiful Soup
- 2 I of IV
- 3 The C's for Once
- 4 The Bath
- ✓ 1 5 Light Piece for D.T. — Repetition technique
- 6 E. D for Piccolo + 7 Conductors
- 2 7 Mnemonics
- 8 AOK
9. Hallo
- 10 Bye Bye Butterfly
- 11 2 of 4

Tape delay ~~not associated~~ techniques for Electronic Music Composition

Whether in the studio or in concert the tape recorder has uses beyond its ~~usual~~ ^{ordinary} recording function and can become part of the processing ensemble in Electronic Music. A common instance of this is tape head reverb. ~~Tape head reverb is so~~ In order to utilize tape head reverb the recorder must have separate record and play back heads ~~and~~ ^{with} access to both circuits,

Comparison ~~which is~~ ^{usually} accomplished by a switch, which allows ~~one~~ ^{of} to compare the incoming signal from the record head to the recorded signal from the play back head.



Simultaneous access to both circuits could be extremely useful to the composer and performer.

FIG. 1a

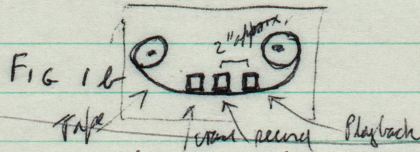


FIG. 1b

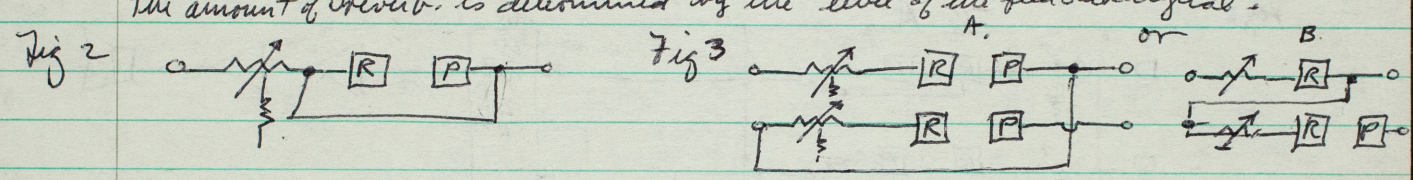
THE DISTANCE BETWEEN HEADS VARIES WITH MFG. THE FIGURES ARE FOR AMPLEX 300-400 SERIES RECORDERS.

In order to utilize this technique in the concert hall microphone placement is critical.

Signals from the record head are simultaneous with the source. (for example the TR as a PA system)

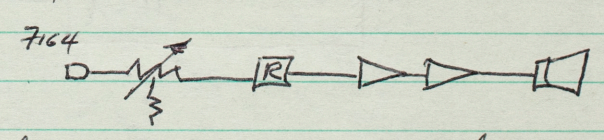
Signals from the playback head are delayed by the distance between the two heads, the tape must travel. Addition of the playback signal to the

direct signal will cause reverberation. (See Fig 2 & 3)
The amount of reverb. is determined by the level of the feedback signal.

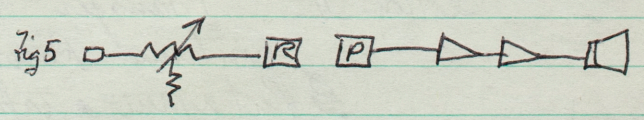


many home tape recorders ^{now} have ~~switches~~ switches to automatically couple ch. 1 to ch 2, ^{through the playback head} or vice versa

If the tape recorder ~~output from~~ ^{from the record head} is fed by a microphone and the output ^{or console hall} is fed into the recording space, the circuit acts as a P.A. system



~~Microphone~~ If the output from the playback head is fed back then reverberation occurs.



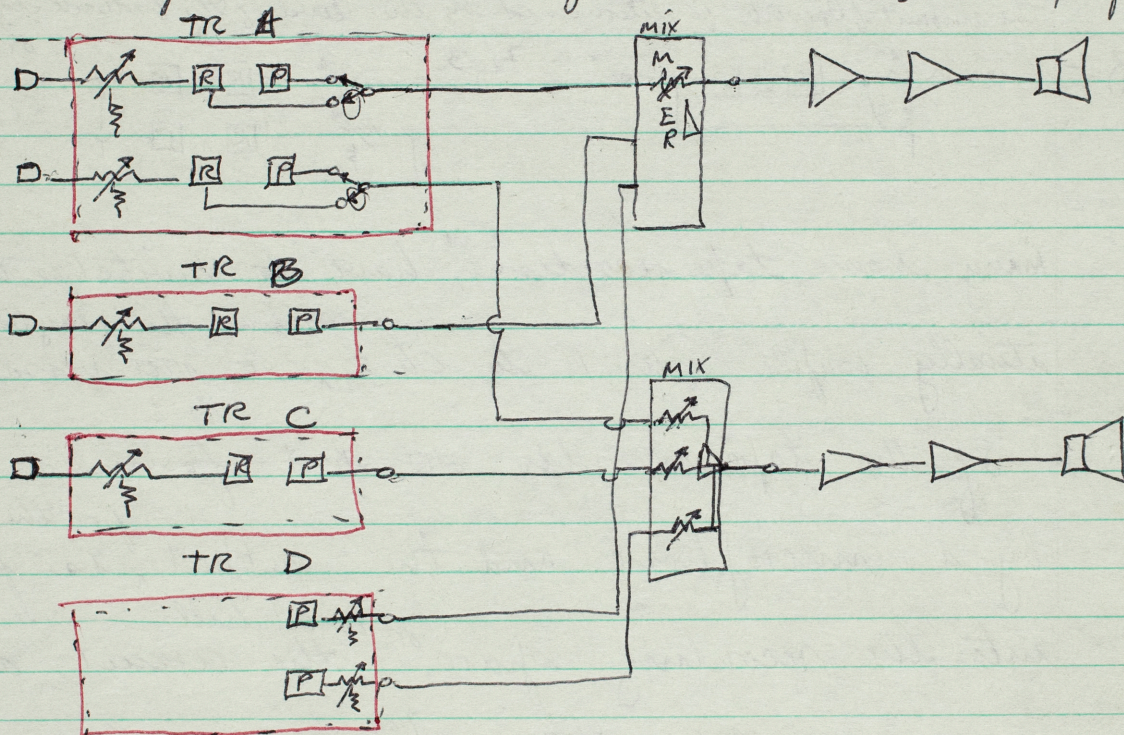
Microphone placement for both circuits is critical unless acoustic feedback is desired.

That is the ~~mic~~ ^{Speaker} pattern must not interfere with the mic pattern.

Fig 6 is the equipment configuration and instructions
for The Bath,¹⁹⁶⁶ a composition for "Dancers Workshop"
in which utilized the dancers as sound sources

and the Tape Recorders as processors during a live performance.

Fig 6



SECTION I RECORD ALL OF DANCER'S' activities with recorders
A, B and C ~~approx 15~~ \pm 20 minutes
Set out put of preamp at zero.

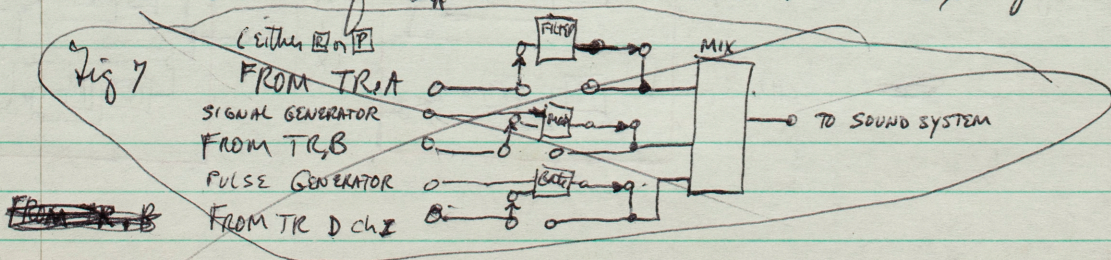
Section II Transfer Tape from Recorder A to recorder ~~B~~
Continue Recording with ~~A+B+C~~ B+C
Put a new tape on recorder A and continue
recording. Gradually open the playback pots
~~the~~ pre-amp pot to maximum acceptable
output for the space on Recorder A during the
next five minutes. Always control feed back
but never make sudden gain adjustments.

Rewind recorders B + C near the end of Section II \pm 20 minutes.

Section III Continue recording with playback pots open on recorder A. Begin to playback recorders B C + D. Continuously select material from all 4 recorders utilizing the 6 mixer pots. End.

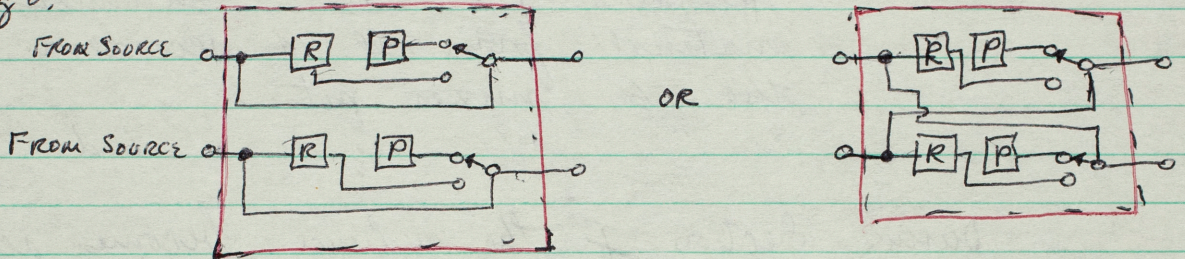
During Section I the audience becomes accustomed to the sound space as it is. The gradual introduction of reverberation in Section II intensifies all the sounds the dancers make and increases the auditory space. Section III introduces various memories of Section I and II. The over all effect is quite complex and can be handled by one performer.

~~Obviously~~ with additional processing equipment such as gates, filters, modulators etc. and/or source sources ~~many~~ variations of ~~the~~ basic techniques ^{of used in The Ba} could occur. For example see Fig. 7.



Cross coupling of ch1 + 2 or a double feedback loop can produce ^{continuous iteration of an} ~~these~~ ^{attacks} effects in a diminuendo ^{until a new attack occurs or} unless a resonant mode is activated.

Fig 8.

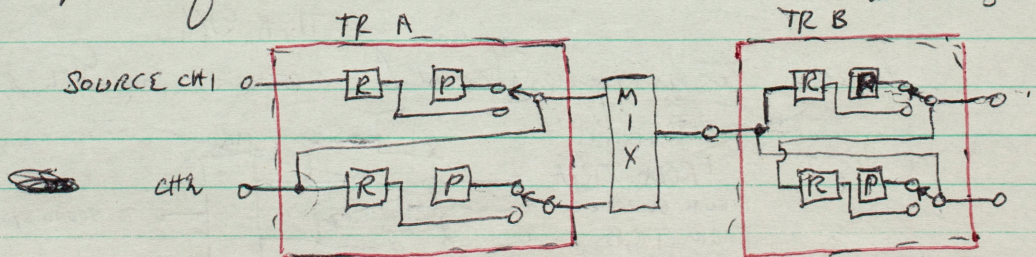


These circuits are difficult to handle and gain controls must be advanced slowly and carefully other wise large ϕ volume feedback builds up quickly.

This type of feed back is particularly effective with long sustained tones and besides reverberation can effect timbre.

In order to get very fast repetition of tones, the following procedure was used for ^{part of} the tape portion of Light Piece for David Tudor-1965 4ch tape \star amplified \star and slight.

Fig 9.

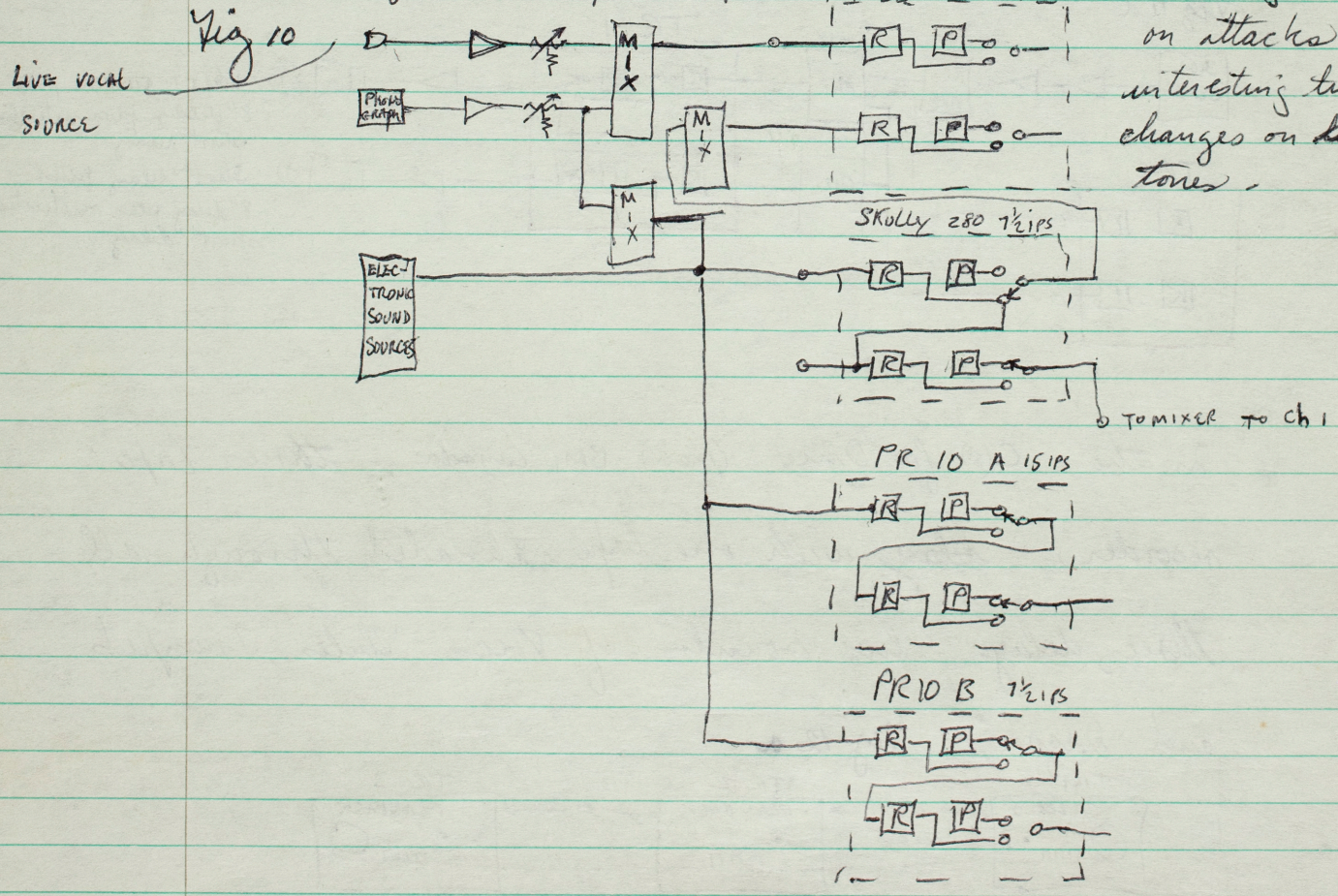


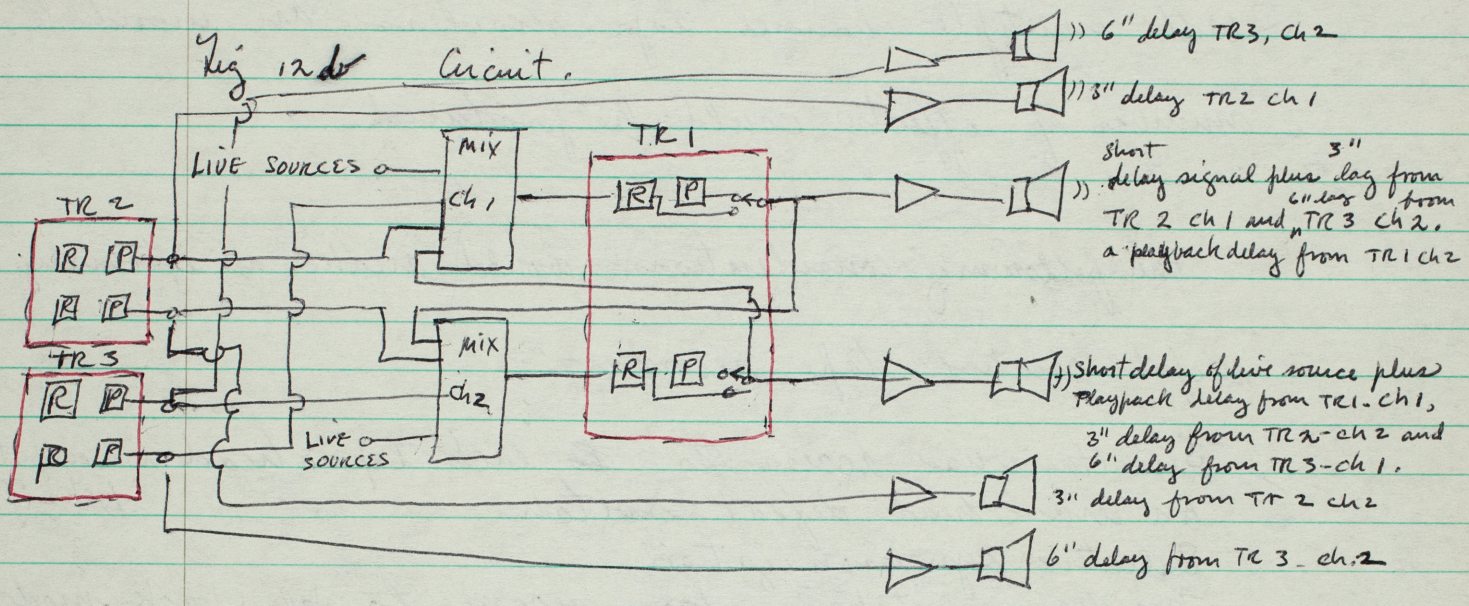
The equipment set up ^(fig. 10) for Beautiful Soup ^{for 2 ch tape} 1967 represents a far more complicated use of ^{small} delay techniques utilizing 4 recorders and exploiting ~~the~~ the difference between head gaps in the Skully 280, Ampex 350, and two Ampex PR 10's operating at 15 and 7 1/2 IPS respectively.

The Skully 280 has about 3" between heads, the Ampex

350 about 2" and the PR 10's about 1" with all the feed back loops in operation there is a shimmering effect

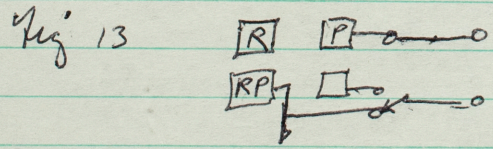
on attacks and interesting timbre changes on sustained tones.





The console operator cues the ~~instrument~~ performers and is instructed ~~how~~ when to introduce the delay lines.

With Selective Synchronization available on tape recorder - a pre-recorded program can be given a pre-echo by listening to one track normally and switching the ~~other~~ ^{duplicate} track to Sel-Sync mode



A Tape recorder with extra heads which could be varied in distance could be a very interesting studio and performance device.

with multiple channel tapes recorders an incredible number of effects could be produced.

The following considerations would make an extremely useful creative tape recorder:

- Simultaneous access to ~~to~~ each tape head via output ^{packs.}
- An erase head defeat switch.
- Selective synchronization
- Noiseless switching from record to playback mode, ^{erase or no erase,} without stopping the transport.
- Playback head before the erase head.
- Extra playback heads adjustable distance from normal playback for fine control of delay lines.
- Multiple channels is 4 to 8.

A very interesting, creative studio and performance tape recorder could be designed with the following considerations:

TAPE DELAY TECHNIQUES FOR ELECTRONIC MUSIC COMPOSITION

Pauline Oliveros

Oct. 1969

Whether in the studio or in concert, the tape recorder has uses beyond its ordinary recording function and can become part of the processing ensemble in electronic music performance and composition. A common instance of this is tape head reverberation.

In order to utilize tape head reverberation the recorder must have separate record and playback heads with access to both circuits. Comparison of the incoming signal from the record head to the recorded signal from the playback head is usually accomplished by a switch. (Fig. 1a)

Signals from the record head are simultaneous with the source. Signals from the playback head are delayed by the distance the tape must travel between the two heads. (Fig. 1b) Addition of the playback signal by means of a feedback loop to the record head will cause reverberation. (Fig. 2 & 3) The amount of reverberation is determined by the level of the feedback signal.

Many home tape recorders now have switches which automatically couple channel 1 to channel 2 from the playback to the record head, respectively and vice versa.

If the tape recorder is fed by a microphone and the output from the record head is fed into the recording space or concert hall, the circuit acts as a P.A. system. (Fig. 4) If the output from the playback head is fed back, then reverberation occurs. (Fig 5) Microphone placement for both circuits is critical unless acoustic feedback is desired. That is, the speaker pattern must not interfere with the microphone pattern.

Fig. 6 shows the equipment circuit for The Bath, 1966, a composition for Ann Halprin's Dancers Workshop, in which I utilized the dancers as sound sources and the tape recorders as processors during a live performance. Following are the instructions:

Section I - Record all of the dancers' activities with recorders A, B and C 20 minutes.

Set output of pre-amp and outputs of tape playbacks at zero.

Section II- Rewind and transfer tape from recorder A to recorder D. Continue recording with B and C. Open the pre-amp pot to maximum acceptable output for the space. Put a new tape on recorder A and continue recording. Open the playback pots gradually during the next five minutes on recorder A. Always control feedback but never make sudden gain adjustments. Rewind recorders B and C near the end of Section II 20 min.

Section III- Continue recording with playback pots open on recorder A. Begin to play back recorders B, C & D. (With playback pots open.) Continuously select material from all four recorders utilizing the six mixer pots. Rewind when necessary.

During Section I the audience becomes accustomed to the sound space as it is. The gradual introduction of reverberation in Section II intensifies all the sounds the dancers make and expands the auditory space. Section III introduces various memories of Section I and II. The overall effect is quite complex and can be handled by one performer.

With additional processing equipment, such as gates, filters, modulators, etc. and/or sound sources, variations of the basic technique used in The Bath could occur. (For examples see Fig. 7)

Crosscoupling or a double feedback loop between channels (Fig. 8) can produce continuous reiteration of an attack until it decays, a new attack occurs or a resonant mode is activated which results in a continuous crescendo. These circuits are difficult to handle and gain controls must be advanced from zero slowly and carefully. Otherwise large volume feedback is likely to build up very quickly. Crosscoupled feedback is quite effective with long sustained tones, produces reverberation and effects timbre changes.

In order to get very fast repetition of attacks the circuit shown in Fig. 9 was used for the part of the tape portion of

Light Piece for David Tudor, 1965. (Four channel tape, amplified piano and light projections.)

The equipment circuit for Beautiful Soup, 1967, two-channel tape (Fig. 10), represents a far more complicated use of small delay techniques utilizing four recorders and exploiting the difference in distance between heads in the Skully 280, Ampex 350 and two Ampex PR 10s operating at 15 and $7\frac{1}{2}$ IPS, respectively. The Skully 280 has about $3\frac{\text{inches}}{\text{inches}}$ between heads, the Ampex 350 about 2 inches, and the PR 10s about 1 inch. (No actual measurements were made. Use of the feedback loops were determined by ear.) With all the feedback loops in operation there is a shimmering effect on attacks and interesting timbre changes on sustained sounds. Because every delay line was controlled by a separate mixing pot, as much or as little feedback as desired was introduced, and each delay line could be treated as a separate source. By sending delay lines to various processing devices, a large number of variations could occur.

I of IV for 2 channel tape, 1966 (CBS Music of Our Time series ODYSSEY 32-160160) utilized one tape threaded through two recorders (Fig. 11a) for an approximate eight second delay plus the shorter crosscoupled delays. Fig. 11b shows the circuit for I of IV. Inserting a mixer in the feedback line provided control over the amount of feedback.

In the C(s) for Once, 1966, (published by BMI Canada) three

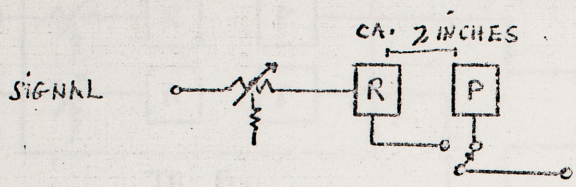
tape recorders with one tape threaded through all three, delay live sounds of voices, flutes, trumpets and organ. (Fig. 12a & b)

The console operator cues the performers and is instructed when to introduce the delay lines during the course of the performance.

A very flexible and interesting studio and performance tape recorder could be designed with the following considerations:

1. Simultaneous access to each head via output jacks which bypass the comparison switch.
2. An erase head defeat switch.
3. Selective synchronization (record head can be switched to playback head).
4. Noiseless switching from record to playback mode, erase or no erase without stopping the tape transport.
5. A playback head before the erase head.
6. Extra playback heads with adjustable distance from the normal playback head for fine control of delay times.
7. Multiple channels, ie. 4 to 8.

FIG. 1a



THE DISTANCE BETWEEN HEADS VARIES WITH MANUFACTURER. FIGURES BELOW ARE FOR AMPEX 350.

OUTPUT DELAY 266 MILLISECONDS AT 7 1/2 IPS
133 " " " " 15 "

FIG. 1b

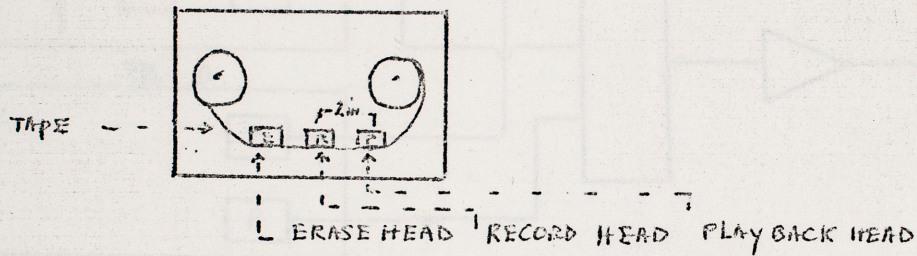


FIG. 2

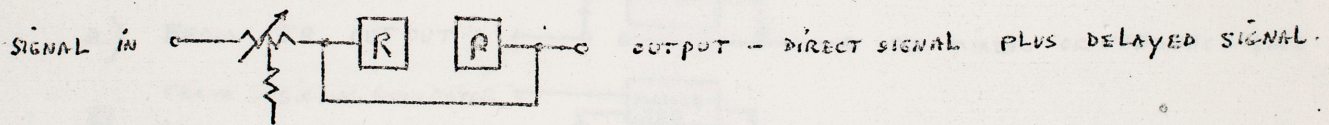


FIG. 3

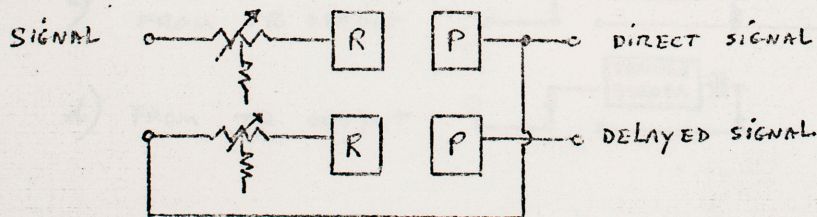
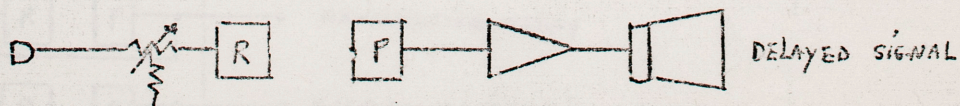


FIG. 4



FIG. 5



6. - THE BATH - 1966

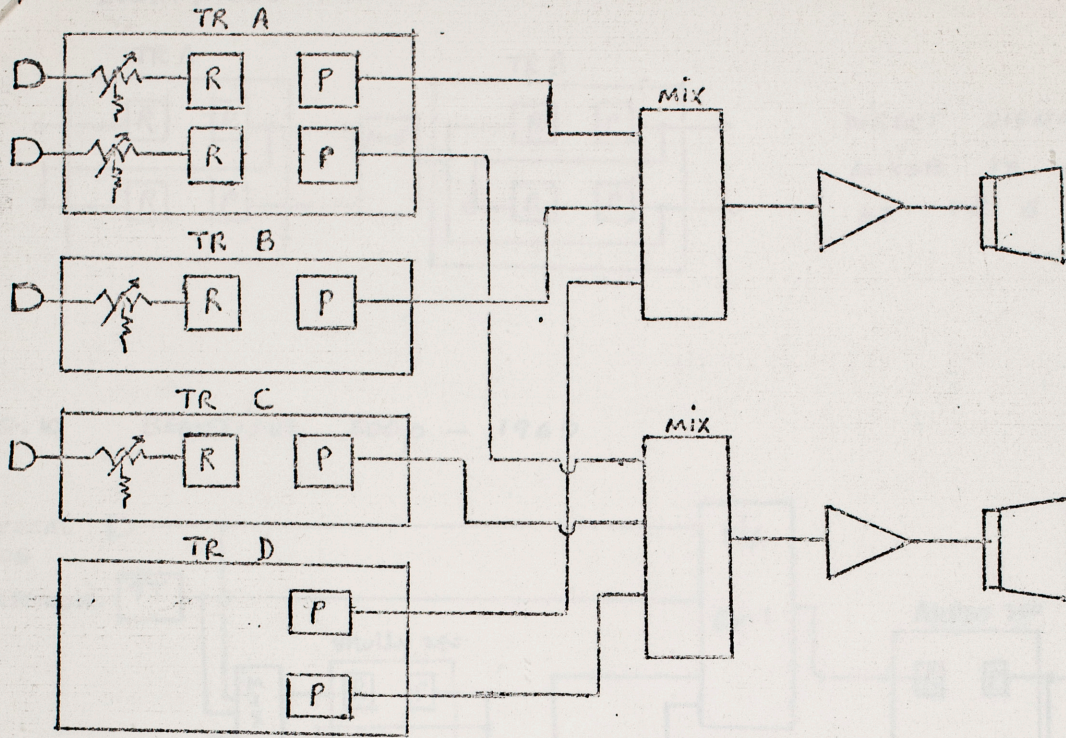


FIG. 7

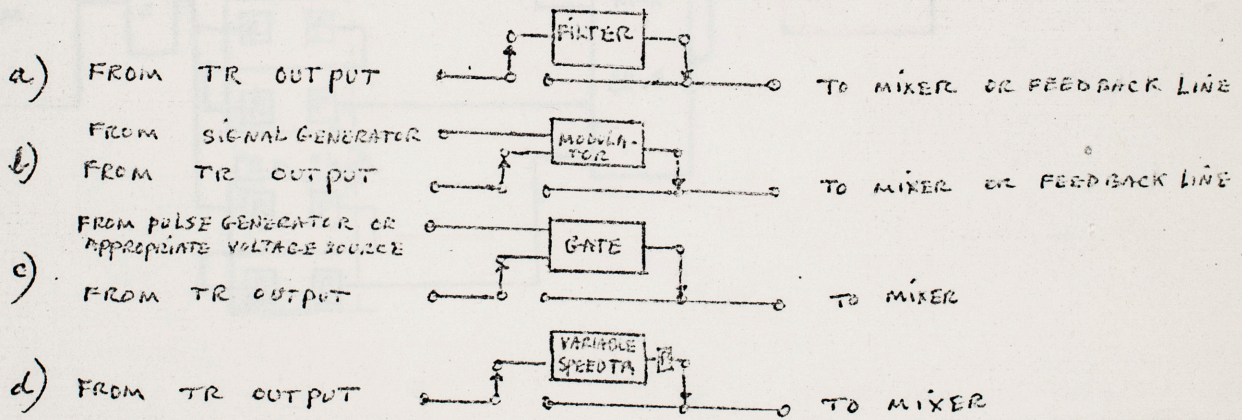
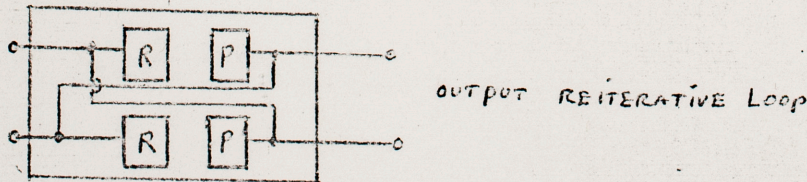
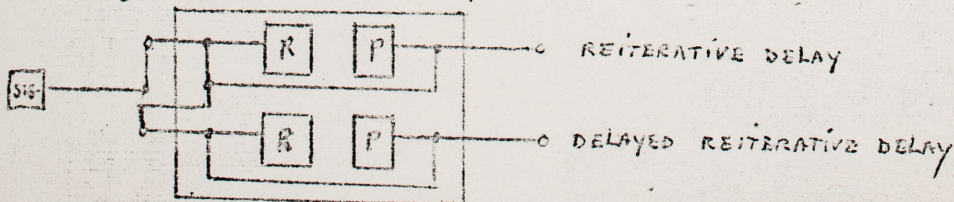


FIG. 8

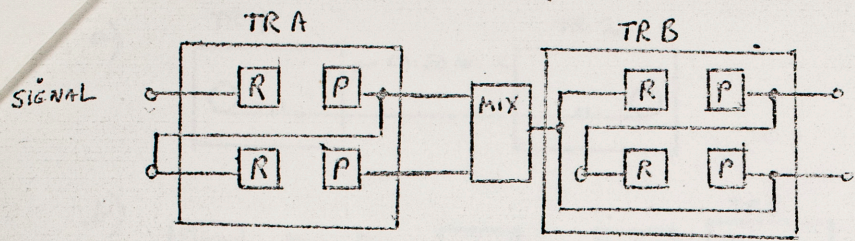
a) CROSS COUPLING



b) DOUBLE FEEDBACK LOOP

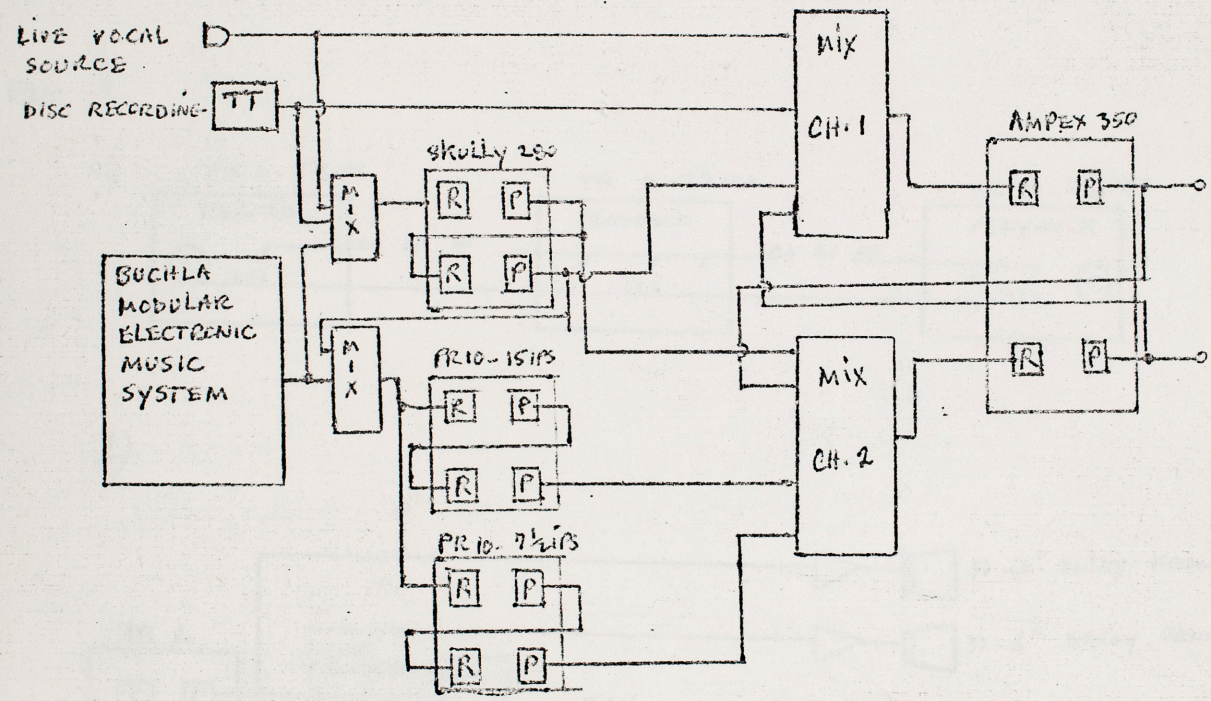


9 LIGHTPIECE FOR DAVID TUDOR - 1965



DIRECT SIGNAL AND DELAY AT MIXER TO REITERATIVE LOOP AT TR B OUTPUTS.

FIG. 10 BEAUTIFUL SCOOP - 1967



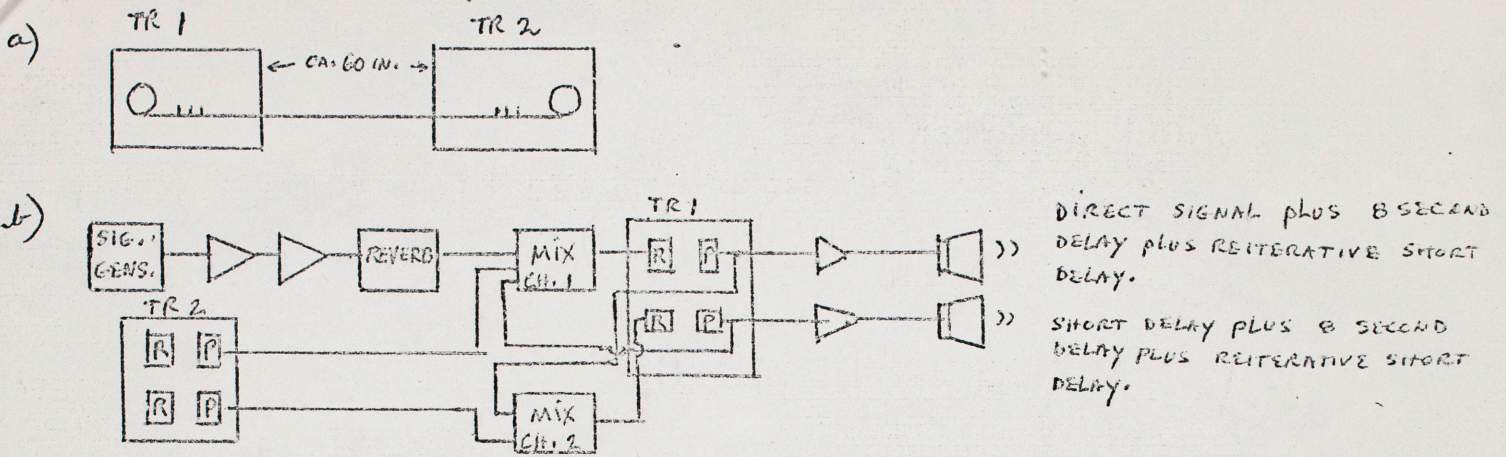
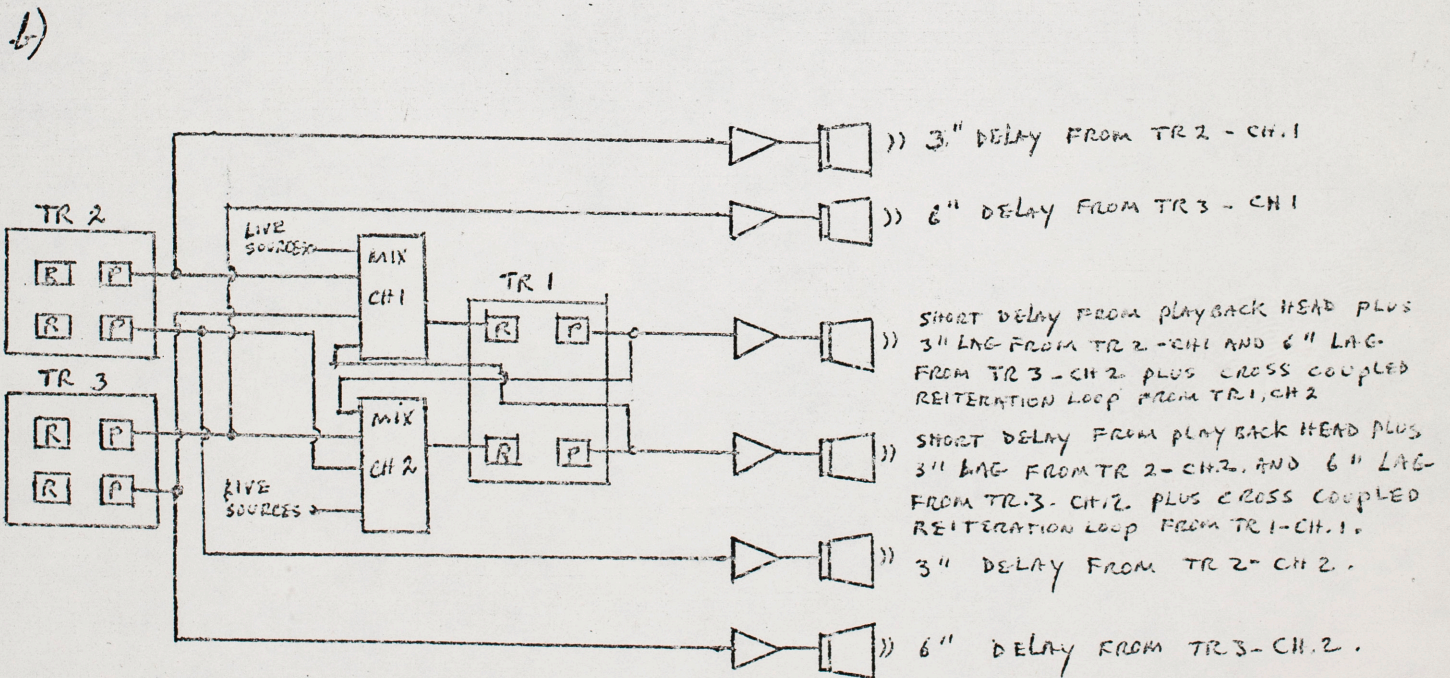
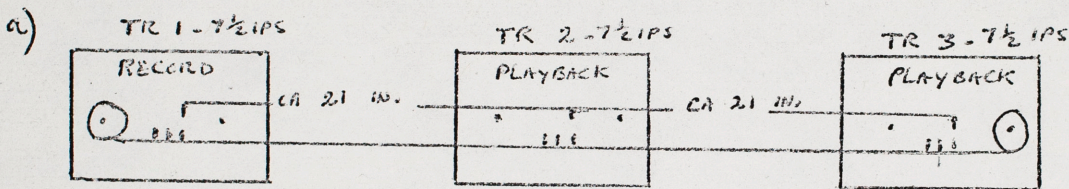
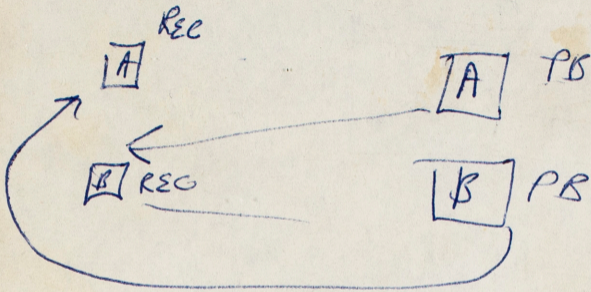


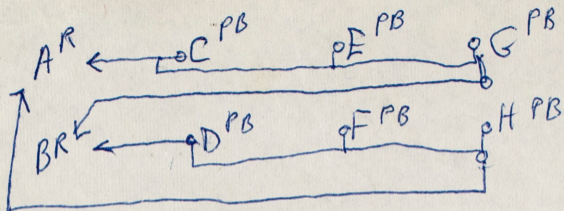
FIG. 12



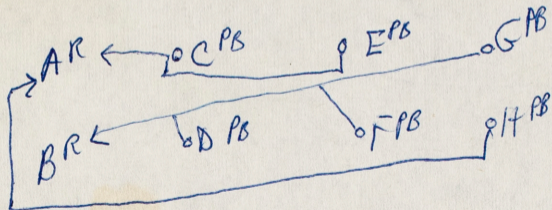
КЭБСА

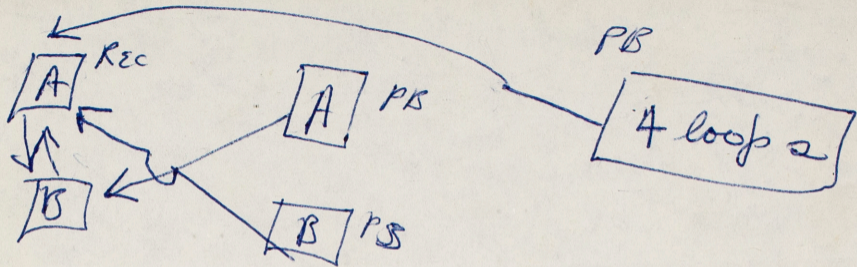


6



7





5

NEW SIG



B PB

C PB

E PB

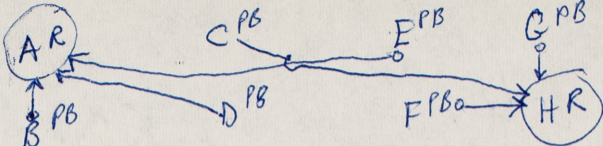
G PB

D PB

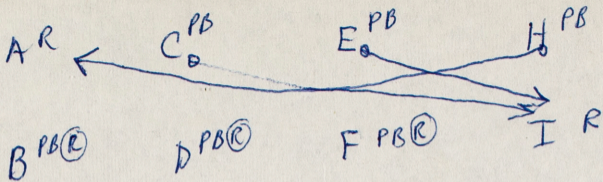
F PB



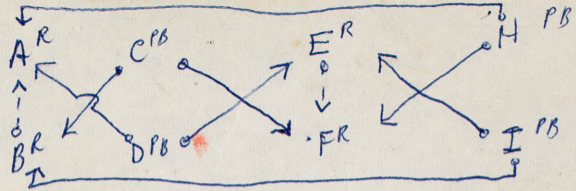
PRZ REC



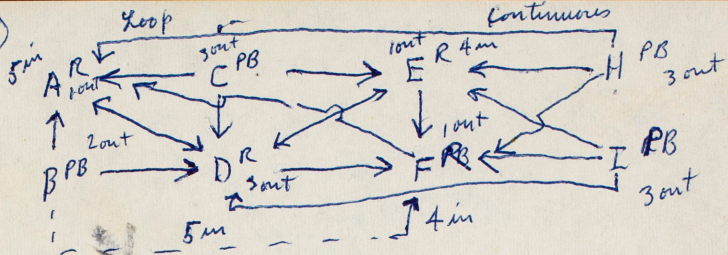
④



3

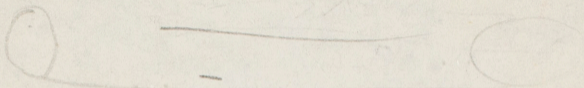


(2)



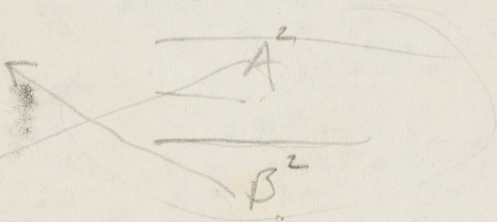
A

B

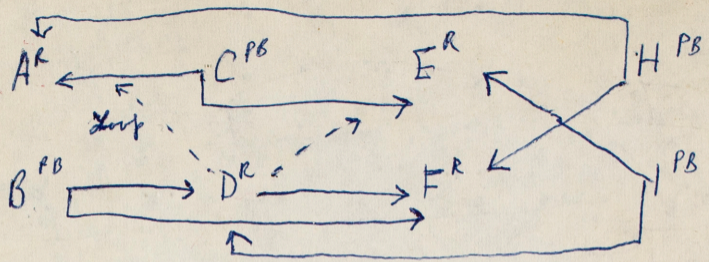


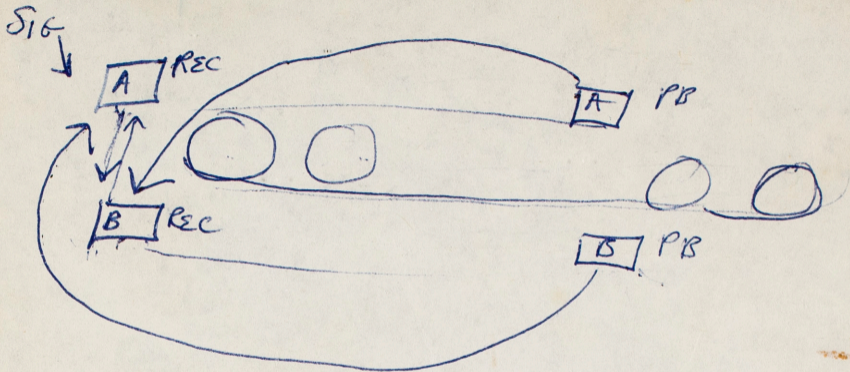
B

A
↓
↑
B
←



①





TAPE DELAY TECHNIQUES FOR ELECTRONIC MUSIC COMPOSITION

Pauline Oliveros
Oct. 1969

Whether in the studio or in concert, the tape recorder has uses beyond its ~~ordinary~~ ^{understood} ~~usual~~ recording function and can become part of the ~~processing~~ ^{modifying} ensemble in electronic music performance and composition. A common instance of this is tape head reverberation.

In order to utilize tape head reverberation the recorder must have separate record and playback heads with access to both circuits. Comparison of the incoming signal ~~from~~ ^{to} the record head ~~to~~ ^{with} the recorded signal from the playback head is usually accomplished by a switch. (Fig. 1a)

Signals ~~from~~ ^{to} the record head are simultaneous with the source. Signals from the playback head are delayed ^(with respect to ~~signal~~ ^{the same signal}) by the distance ~~the~~ ^{to the record} tape must travel between the two heads. (Fig. 1b) ^{Since this is ~~the~~ ^{head})} ^{addition of} the playback signal by means of a feedback loop to the record head will ~~thus~~ ^{cause} reverberation. (Fig. 2 & 3) The ~~amount~~ ^{amplitude} of reverberation is determined by the level of the feedback signal.

Many home tape recorders now have switches which automatically ~~connect~~ ^{direct} the signal from channel 1 playback head to channel 2 ~~couple~~ ^{record head,} ~~channel 1 to channel 2 from the playback to the record head,~~ ^{respectively} and vice versa.

If a microphone is connected to the mic input of the tape recorder and the signal from the microphone is fed through the recording electronics to the recording space or concert hall, the circuit acts as a P.A. (public address) system. (Fig. 4) If the output from the playback head is fed back, then reverberation occurs.

(Fig 5) Microphone placement for both circuits is critical unless acoustic feedback is desired. That is, the loudspeaker should not be the same as the microphone, ~~not interfere with the microphone pattern~~ unless acoustic feedback is desired. ^{through the playback electronics to the above} ~~loudspeaker sound field of the~~ ^{space,} ~~pattern must~~ ^{loudspeaker sound field of the} ~~not interfere with the microphone pattern~~ ^{unless acoustic feedback is desired.}

Fig. 6 shows the equipment circuit for The Bath, 1966, a composition for Ann Halprin's Dancers Workshop, in which I utilized the dancers as sound sources and the tape recorders as processors ^{modifiers} during a live performance. Following are the instructions:

Section I - Record all of the dancers' activities with recorders A, B and C 20 minutes.

Set output of pre-amp and outputs of tape playbacks at zero.

Section II- Rewind and transfer tape from recorder A to recorder D. Continue recording with B and C. Open the pre-amp pot to maximum acceptable output for the space. Put a new tape on recorder A and continue recording. Open the playback pots gradually during the next five minutes on recorder A. Always control feedback but never make sudden gain adjustments. Rewind recorders B and C near the end of Section II 20 min.

- Process:
- 1) a word that creates more trouble than its worth (Campbell)
 - 2) a series of actions or operations definitely conducing to an end; continuous operation or treatment (Webster's)
 - 3) how about:
- Modify:
- 1) to change somewhat the form or qualities of; (Webster's)
 - 2) think about it.

Section III- Continue recording with playback pots open on recorder A. Begin to play back recorders B, C & D. (With playback pots open.) Continuously select material from all four recorders utilizing the six mixer pots. Rewind when necessary.

During Section I the audience becomes accustomed to the sound space as it is. The gradual introduction of reverberation in Section II intensifies all the sounds the dancers make and expands the auditory space. Section III introduces various memories of Section I and II. The overall effect is quite complex ~~and~~ ^{although it} can be handled by one performer.

With additional ^{modifying} ~~processing~~ equipment, such as gates, filters, modulators, etc. and/or sound sources, variations of the basic technique used in The Bath could occur. (For examples see Fig. 7)

Crosscoupling or a double feedback loop between channels (Fig. 8) can produce continuous reiteration of an attack until it decays, a new attack occurs or a resonant mode is activated which results in a continuous crescendo. These circuits are difficult to handle and gain controls must be advanced from zero slowly and carefully. Otherwise large volume feedback is likely to build up very quickly. Crosscoupled feedback is quite effective with long sustained tones, produces reverberation and effects timbre changes.

In order to get very fast repetition of attacks the circuit shown in Fig. 9 was used for the part of the tape portion of

Light Piece for David Tudor, 1965. (Four channel tape, amplified piano and light projections.)

The equipment circuit for Beautiful Soup, 1967, two-channel tape (Fig. 10), represents a far more complicated use of small delay techniques utilizing four recorders and exploiting the difference in distance between heads in the Skully 280, Ampex 350 and two Ampex PR 10s operating at 15 and $7\frac{1}{2}$ IPS, respectively. The Skully 280 has about $3\frac{\text{inches}}{\text{inches}}$ between heads, the Ampex 350 about 2 inches, and the PR 10s about 1 inch. (No actual measurements were made. Use of the feedback loops were determined by ear.) With all the feedback loops in operation there is a shimmering effect on attacks and interesting timbre changes on sustained sounds. Because every delay line was controlled by a separate mixing pot, as much or as little feedback as desired was introduced, and each delay line could be treated as a separate source. By sending delay lines to various ~~processing~~^{MODIFYING} devices, a large number of variations could occur.

I of IV for 2 channel tape, 1966 (CBS Music of Our Time series ODYSSEY 32-160160) utilized one tape threaded through two recorders (Fig. 11a) for an approximate eight second delay plus the shorter crosscoupled delays. Fig. 11b shows the circuit for I of IV. Inserting a mixer in the feedback line provided control over the amount of feedback.

In the C(s) for Once, 1966, (published by BMI Canada) three

most of the diagrammed circuits can be set up using home equipment. (but Tape Recorders must have ^{separate} record + playback heads) mixers for isolating the input signals can be the \$5.00 variety. (Lafayette lat. no) 4 in one out.

VOCAL SOURCE

ALL SOURCES

- a) DIRECT
 - b) DELAYED BY SK. 280
 - c) DELAYED BY AMPEX 350 CH2
- } SEPARATELY OR SIMULTANEOUSLY

ALL SOURCES

- a) DELAYED BY AMPEX 350 CH 1
 - b) DELAYED BY SK. 280
 - c) " " BY PR 10-15 IPS
 - d) " " " PR 10-7 1/2 IPS
- } SEPARATELY OR SIMULTANEOUSLY

Thurs.

Pauline,

Pardon us butting in to matters (academic) which don't concern us
BUT.....

With 72 kids in your IA class,
5 available days a week (for recorder check-out by office people)
and 11 recorders.....

that amounts to 15 kids a day who need a recorder
and TOTAL BEDLAM trying to accomodate them plus
the others.

How 'bout setting up the assignments so that it is due at X time, but tell
the kids that Algermissen through Farkas will use the machines on Monday,
Fischer through La Motte on Tuesday, etc... Anyone who doesn't show up to
get his machine on the assigned day will have to wait until the end of the
week and try again.

If this is OK with you, drop me a note today and I'll
work out the system.

Leandra

tape recorders with one tape threaded through all three, delay live sounds of voices, flutes, trumpets and organ. (Fig. 12a & b)

The console operator cues the performers and is instructed when to introduce the delay lines during the course of the performance.

A very flexible and interesting studio and performance tape recorder could be designed with the following considerations:

1. Simultaneous access to each head via output jacks which bypass the comparison switch. (Input/Repro)

② An erase head defeat switch. A useful ~~to~~ overlay function even though the record head erases the signal somewhat.

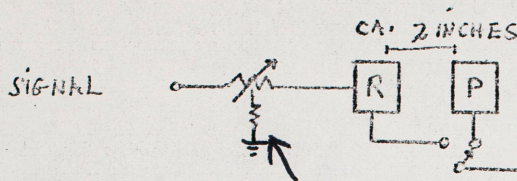
3. Selective synchronization (record head can be switched to playback head.
4. Noiseless switching from record to playback mode, erase or no erase without stopping the tape transport.
5. A playback head before the erase head.
6. Extra playback heads with adjustable distance from the normal playback head for fine control of delay times.
7. Multiple channels, ie. 4 to 8.

the record head erases the signal somewhat, as you know.

most of the diagrammed circuits can be set up using home equipment, provided that the tape recorders have separate record and playback heads. 4 in one out mixers for isolating the input signals are available for \$5 from Lafayette Radio (Cat 99T4535 mono) All feedback loops are accomplished by external patching.

The stereo mixer is not recommended.

FIG. 1a

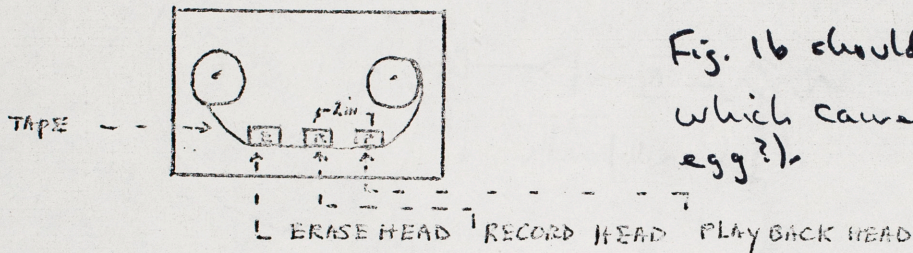


THE DISTANCE BETWEEN HEADS VARYS WITH MANUFACTURER, FIGURES BELOW ARE FOR AMPEX 350.

OUTPUT DELAY 266 MILLISECDS AT 1 1/2 IPS
133 " " " " 15 "

What the hell is this?

FIG. 1b



In order to communicate effectively,

Fig. 1b should come before fig. 1a (or which came first: the chicken or the egg?)

FIG. 2

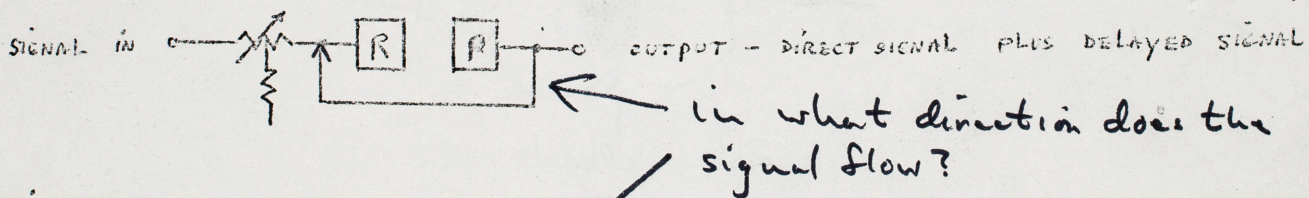


FIG. 3

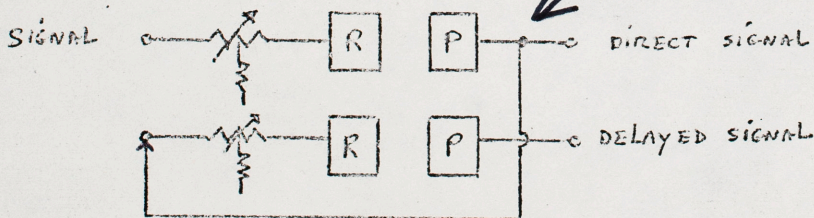


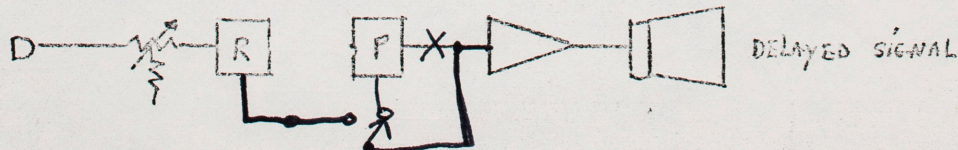
Fig. 3: the coupling of ch. 1 to ch. 2 is not operative while recording on ch. 1 (in most machines) as you have shown.

FIG. 4



see other side of page.

FIG. 5



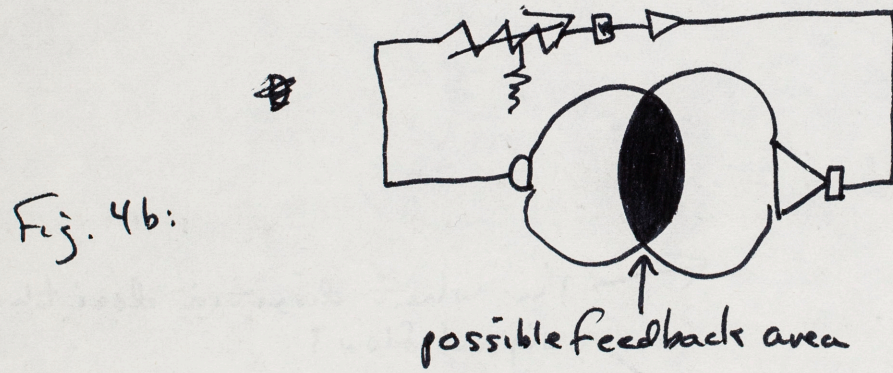
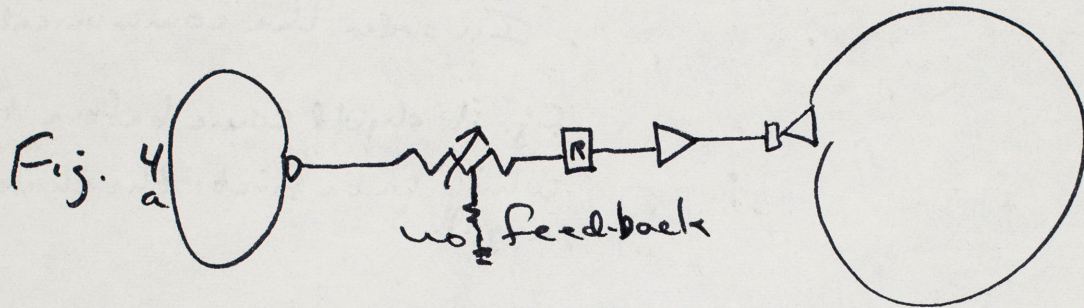


FIG. 6. - THE BATH - 1966

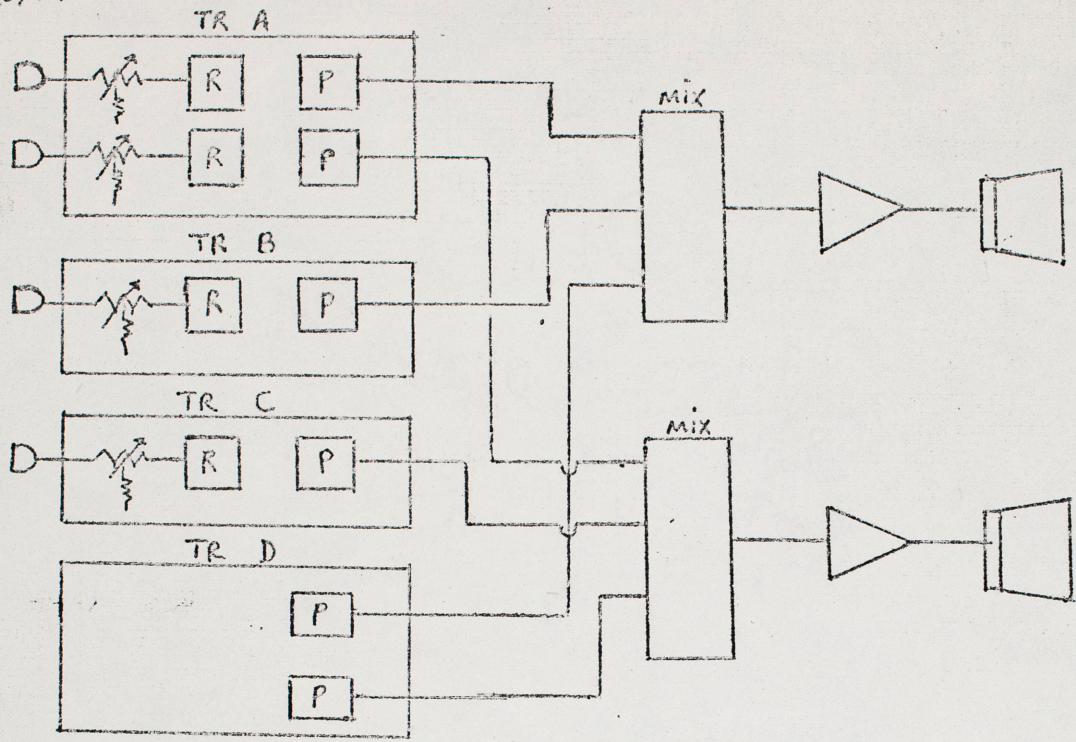


FIG. 7

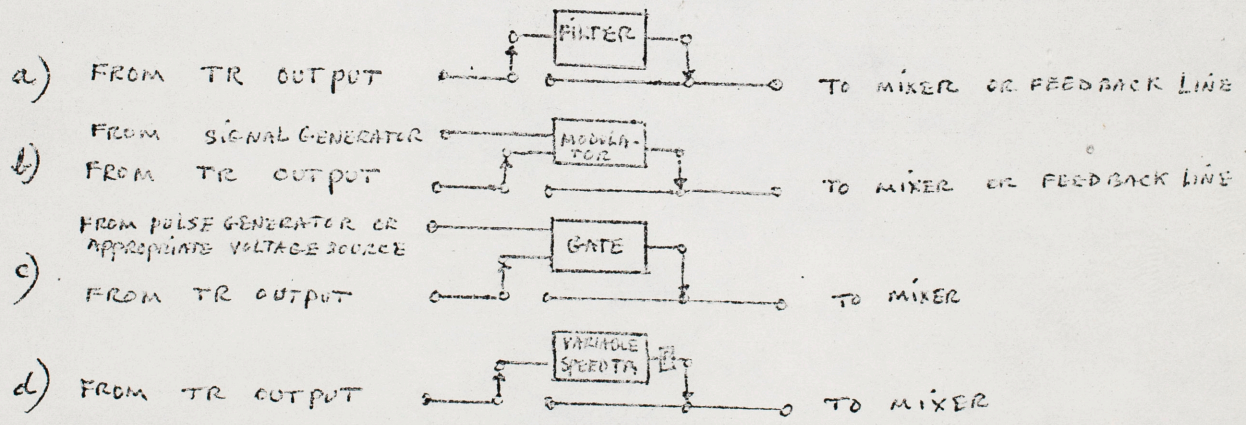
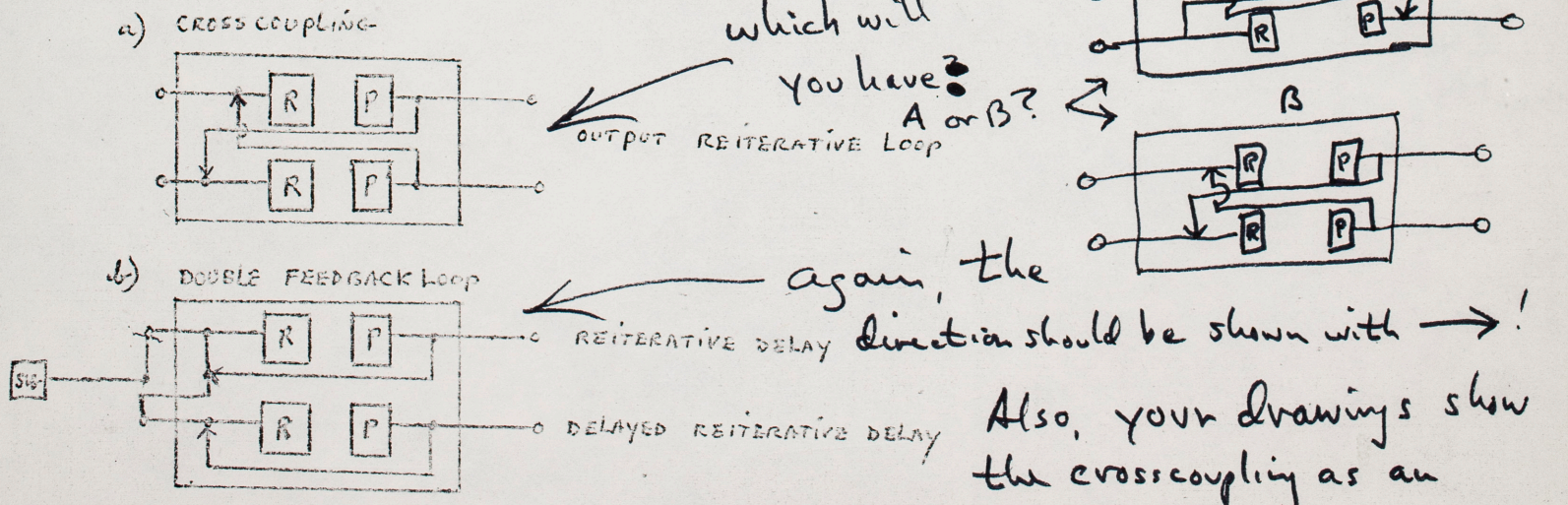
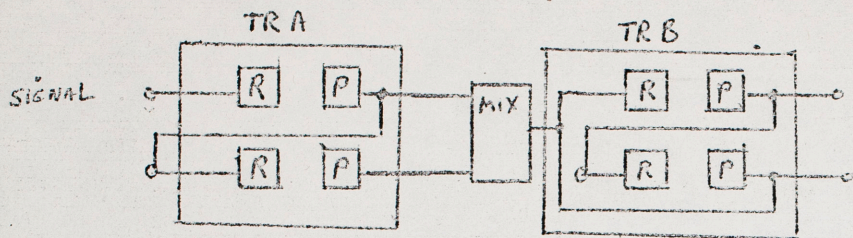


FIG. 8



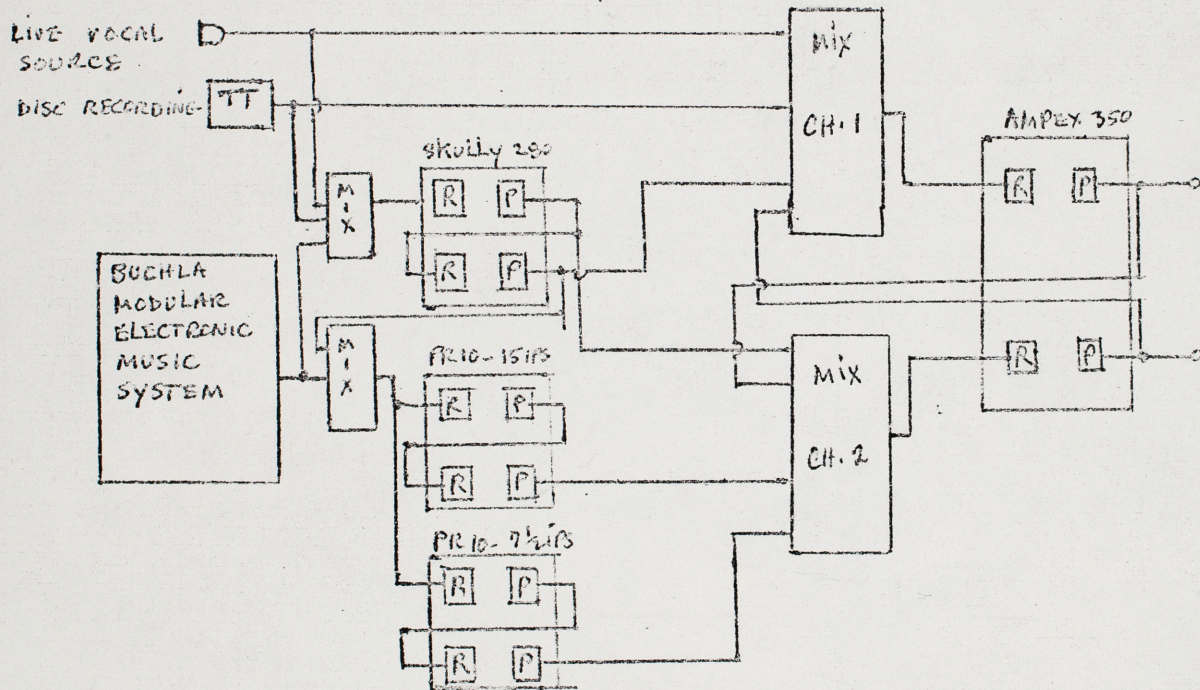
Also, your drawings show the crosscoupling as an internal wiring configuration; we both know that no technician would dare to do this!

.. FIG. 9 LIGHTPIECE FOR DAVID TUDOR - 1965



DIRECT SIGNAL AND DELAY AT MIXER TO REITERATIVE LOOP AT TR B OUTPUTS.

FIG. 10 BEAUTIFUL SCOOP - 1967



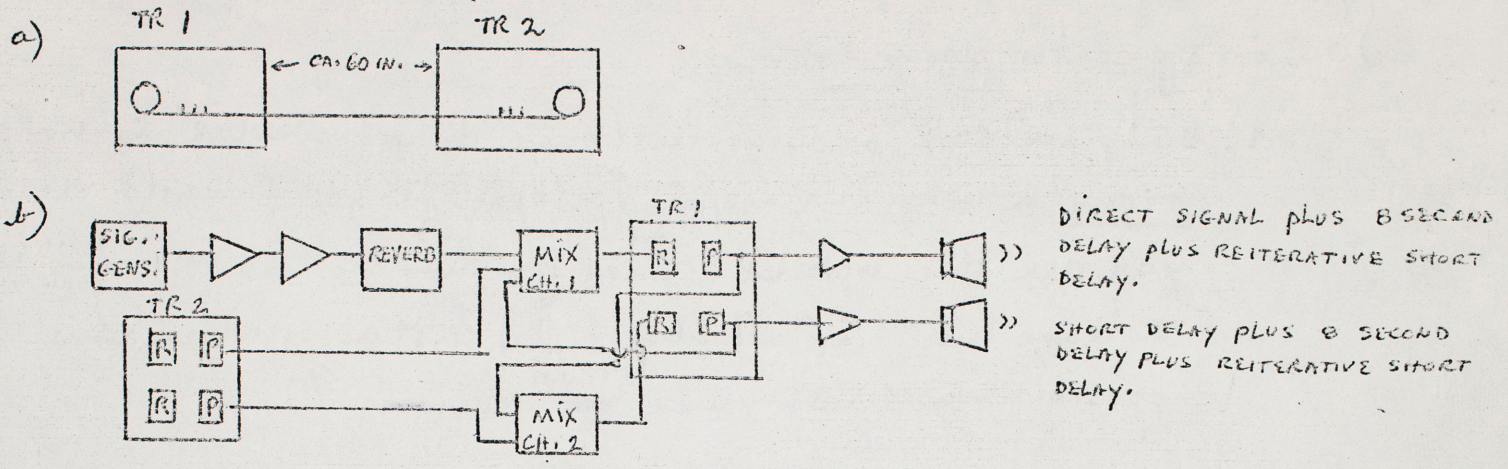
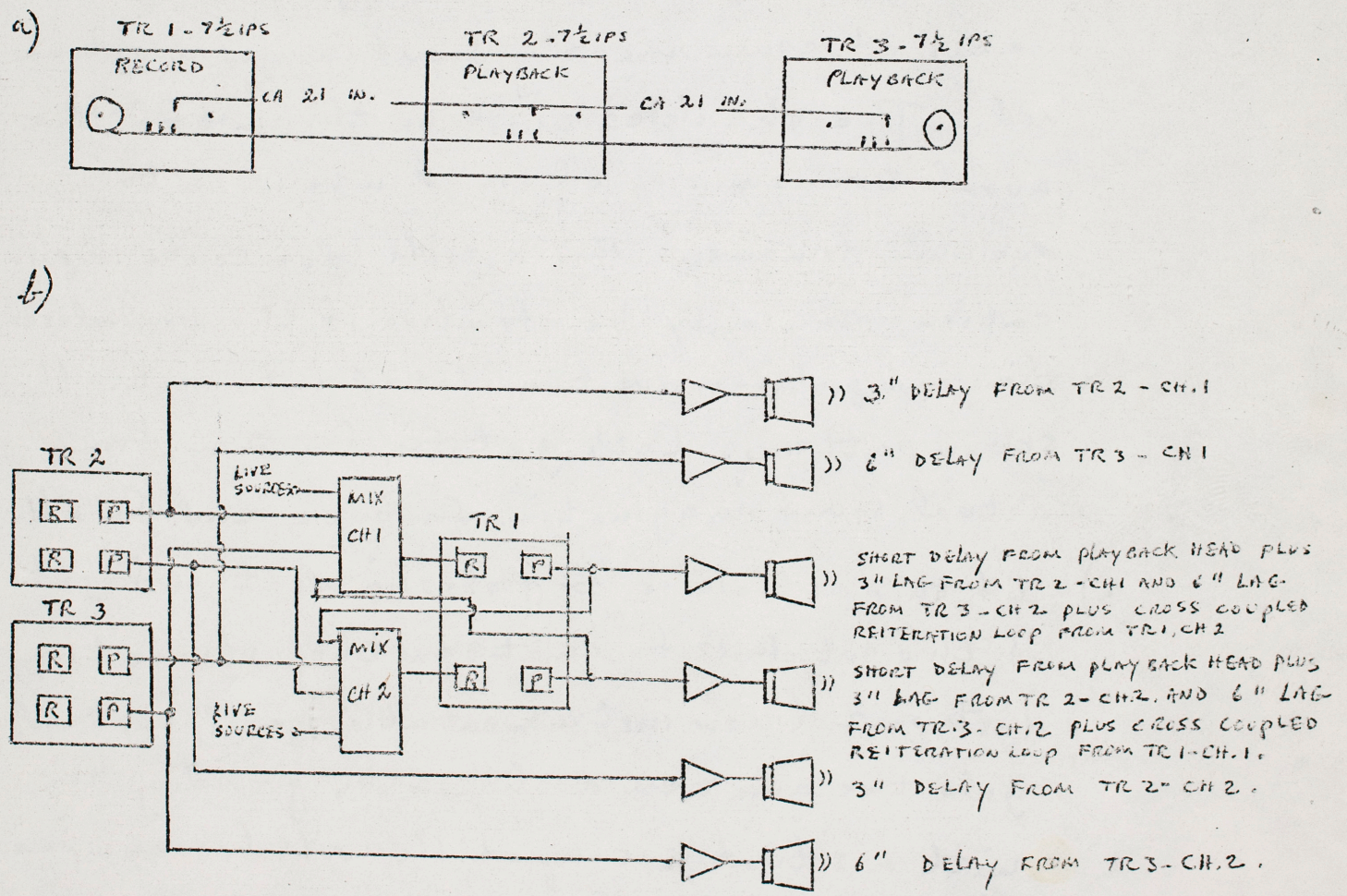


FIG. 12 C's for Once - 1966



for I of IV and C's for Once the schematic show each T.R. as a separate entity. This is not so if ^{one} tape is stretched between all machines. We used a new symbol for this.



(OVER)

Some specific points:

- 1) only in one peculiar instance do we derive signals from a recording head (selsyac); ergo, I would recommend you use the normal signal path — to the recording head. I have modified all (hopefully) instances where this possible mis construction ^{could} ~~be~~ occurred.
- 2) all talk and pictures. In this age and at this stage of our technological development a better means of communicating sound images must be had. The shackles must be thrown off the aural transmission of sound in relation to publishing demands. This article, due to its implication, can only be effective if the word-descriptions and pictures are translated into actual sound patterns. Let's get far, far away from actual sound imaginations for once and for all.
- 3) If this article is for professionals then forget it; if this article is for amateurs then strike the last part (new instrumentation) and, instead, give the amateur a chance by providing him with a situation compatible with his equipment.

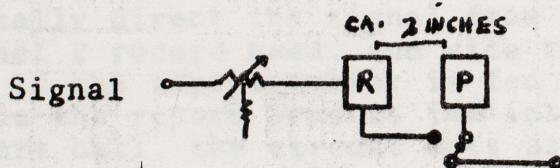
TAPE DELAY TECHNIQUES FOR ELECTRONIC MUSIC COMPOSITION

PAULINE OLIVEROS

Whether in the studio or in concert, the tape recorder has uses beyond its ordinary recording function and can become part of the modifying ensemble in electronic music performance and composition. A common instance of this is tape head reverberation.

In order to utilize tape head reverberation the recorder must have separate record and playback heads with access to both circuits. Comparison of the incoming signal to the record head with the recorded signal from the playback head is usually accomplished by a switch. (Fig. 1a)

1a

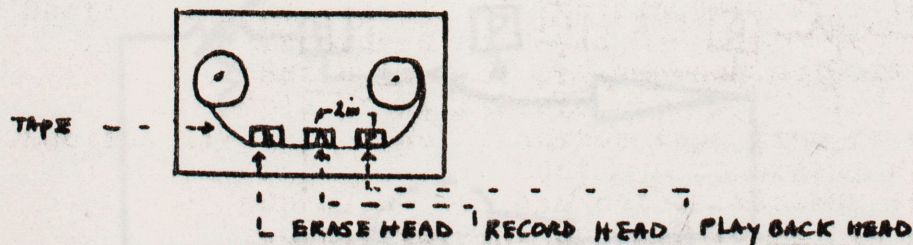


The distance between heads varies with manufacturer. Figures below are for Ampex 350.

Output delay
 266 milliseconds at 7 1/2 ips
 133 " " " " 15 "

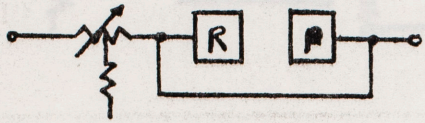
Signals to the record head are simultaneous with the source. Signals from the playback head are delayed with respect to the record head by the distance the tape must travel between the two heads. (Fig. 1b) Addition of the playback signal by means of a feedback loop to the record head will cause reverberation. (Fig. 2 and 3) The amplitude of reverberation is determined by the level of the feedback signal.

1 b



2

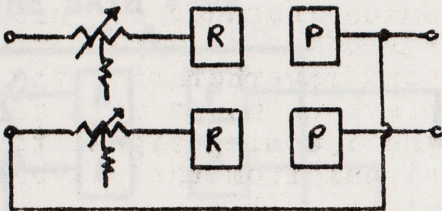
Signal in



Output - Direct signal plus delayed signal.

3

Signal



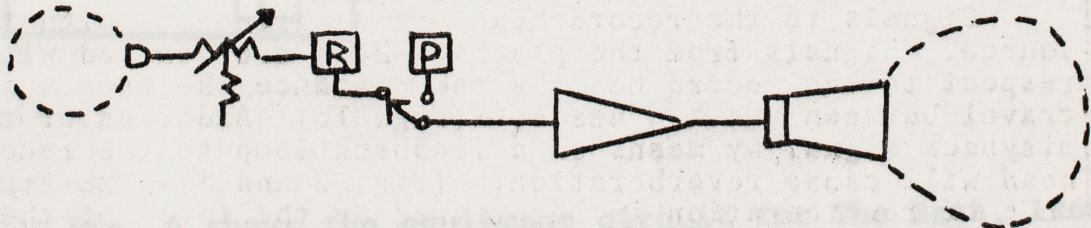
Direct signal

Delayed signal

Many home tape recorders now have switches which automatically direct the signal from channel 1 playback head to channel 2 record head, and vice versa.

If the tape recorder is fed by a microphone and the output to the record head is fed into the recording space or concert hall, the circuit acts as a P.A. (public address) system. (Fig. 4a) If the output from the playback head is fed back, then reverberation occurs. (Fig. 5) Microphone placement for both circuits is critical unless acoustic feedback is desired. That is, the speaker sound field must not interfere with the microphone sound field. (Fig. 4b)

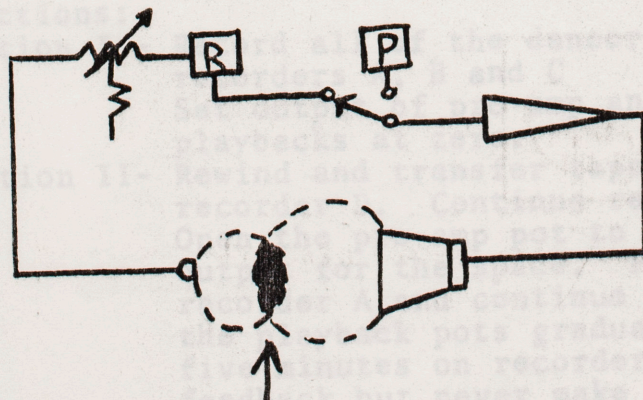
4 a



no feedback

direct signal

b



possible feedback area

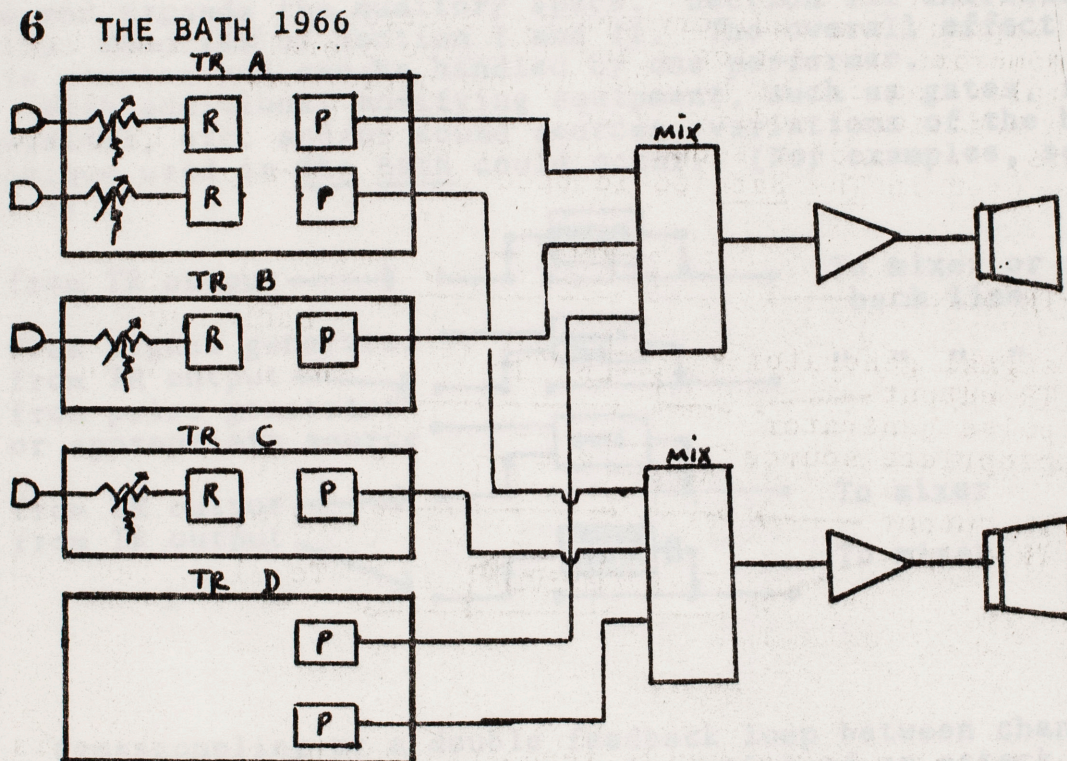
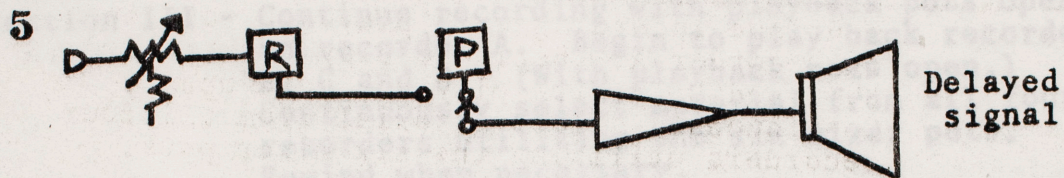


Fig. 6 shows the equipment circuit for The Bath, 1966, a composition for Ann Halprin's Dancers Workshop, in which I utilized the dancers as sound sources and the tape recorders as modifiers during a live performance. Following are the instructions:

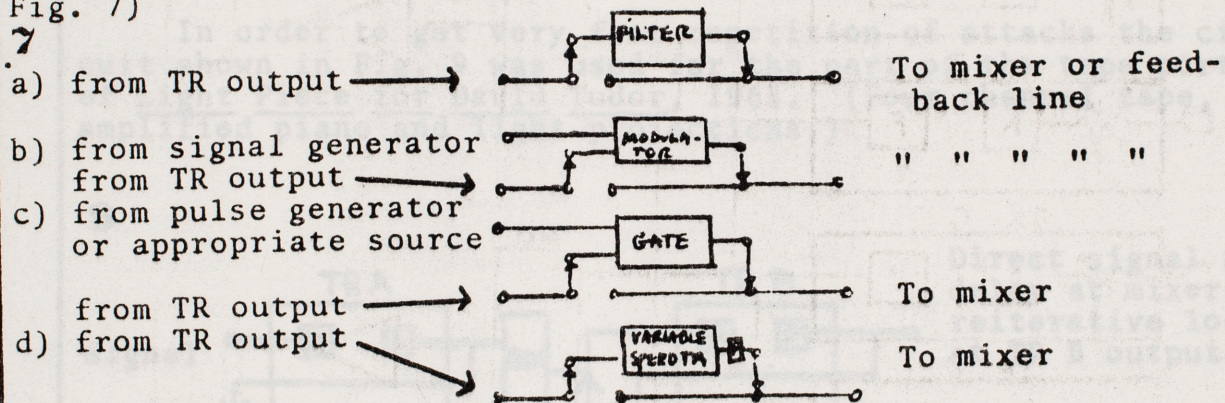
Section I - Record all of the dancers' activities with recorders A, B and C 20 minutes.
Set output of pre-amp and outputs of tape playbacks at zero.

Section II- Rewind and transfer tape from recorder A to recorder D. Continue recording with B and C. Open the pre-amp pot to maximum acceptable output for the space. Put a new tape on recorder A and continue recording. Open the playback pots gradually during the next five minutes on recorder A. Always control feedback but never make sudden gain adjustments. Rewind recorders B and C near the end of Section II 20 minutes.

Section III - Continue recording with playback pots open on recorder A. Begin to play back recorders B, C and D. (With playback pots open.) Continuously select material from all four recorders utilizing the six mixer pots. Rewind when necessary.

During Section I the audience becomes accustomed to the sound space as it is. The gradual introduction of reverberation in Section II intensifies all the sounds the dancers make and expands the auditory space. Section III introduces various memories of Section I and II. The overall effect is quite complex and can be handled by one performer.

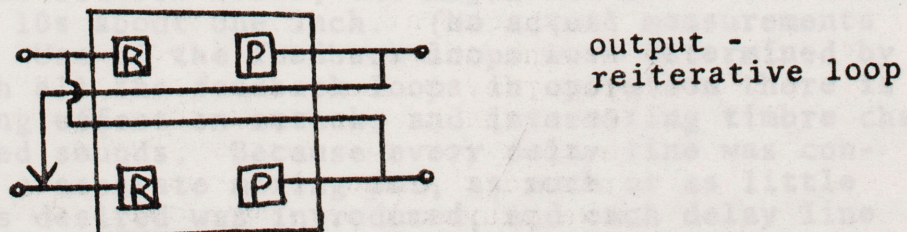
With additional modifying equipment, such as gates, filters, modulators, etc. and/or sound sources, variations of the basic technique used in The Bath could occur. (For examples, see Fig. 7)



Crosscoupling or a double feedback loop between channels (Fig. 8) can produce continuous reiteration of an attack until it decays, a new attack occurs or a resonant mode is activated which results in a continuous crescendo. These circuits are difficult to handle and gain controls must be advanced from zero slowly and carefully. Otherwise large volume feedback is likely to build up very quickly. Crosscoupled feedback is quite effective with long sustained tones, produces reverberation and effects timbre changes.

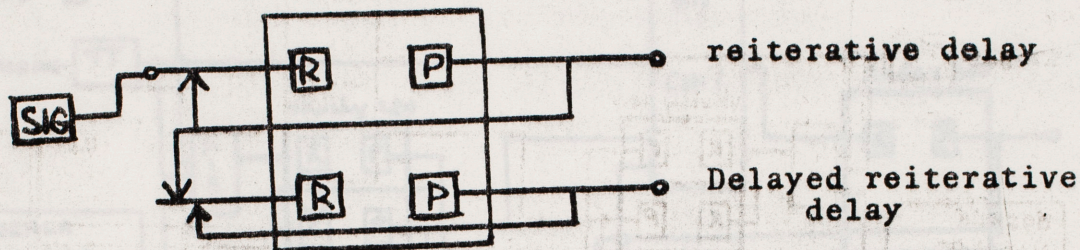
8 a

cross coupling



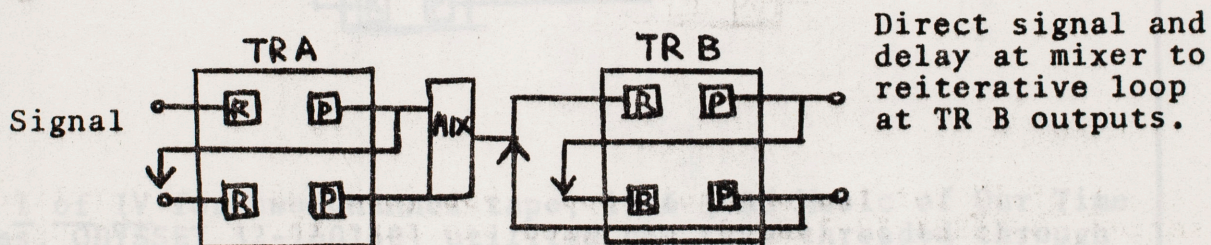
8 b

Double feedback loop

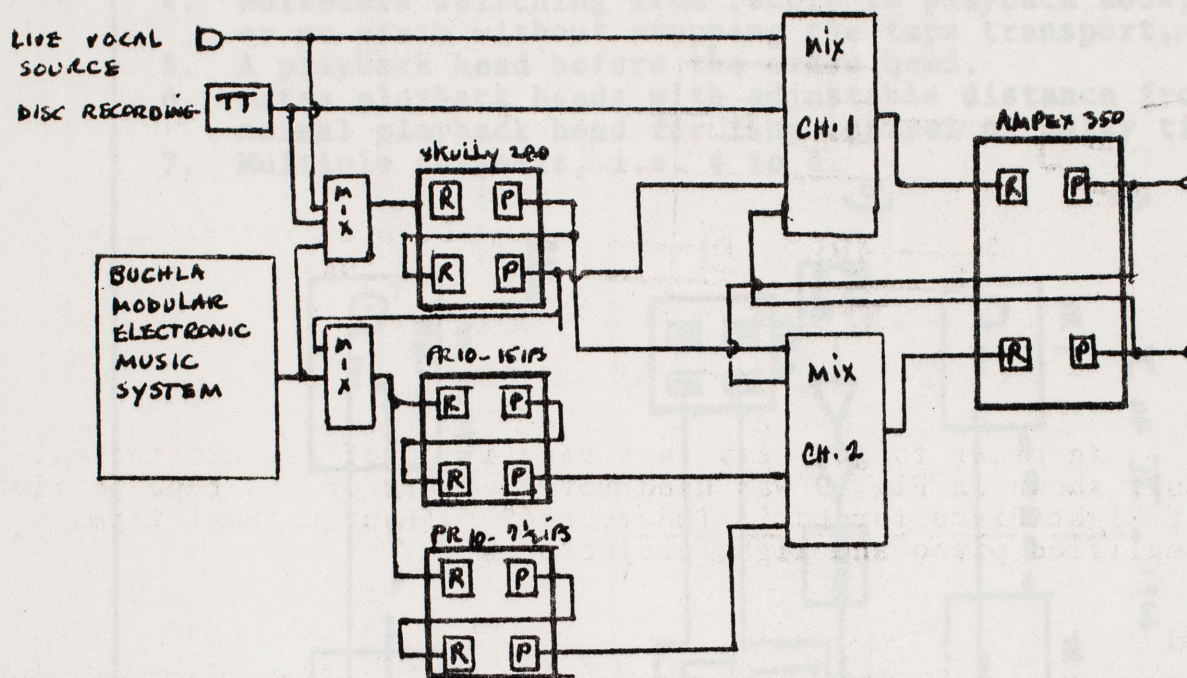


In order to get very fast repetition of attacks the circuit shown in Fig. 9 was used for the part of the tape portion of Light Piece for David Tudor, 1965. (Four channel tape, amplified piano and light projections.)

9



The equipment circuit for Beautiful Soop, 1967, two-channel tape (Fig. 10), represents a far more complicated use of small delay techniques utilizing four recorders and exploiting the difference in distance between heads in the Skully 280, Ampex 350 and two Ampex PR 10s operating at 15 and 7 1/2 IPS, respectively. The Skully 280 has about three inches between heads, the Ampex 350 about two inches, and the PR 10s about one inch. (No actual measurements were made. Use of the feedback loops were determined by ear.) With all the feedback loops in operation there is a shimmering effect on attacks and interesting timbre changes on sustained sounds. Because every delay line was controlled by a separate mixing pot, as much or as little feedback as desired was introduced, and each delay line could be treated as a separate source. By sending delay lines to various modifying devices, a large number of variations could occur.



I of IV for two-channel tape, 1966 (CBS Music of Our Time series, ODYSSEY 32-160160) utilized one tape threaded through two recorders (Fig. 11a) for an approximate eight second delay plus the shorter crosscoupled delays. Fig. 11b shows the circuit for I of IV. Inserting a mixer in the feedback line provided control over the amount of feedback.

In the *C(s)* for *Once*, 1966 (published by BMI Canada), three tape recorders with one tape threaded through all three, delay live sounds of voices, flutes, trumpets and organ (Fig. 12a and b).

The console operator cues the performers and is instructed when to introduce the delay lines during the course of the performance.

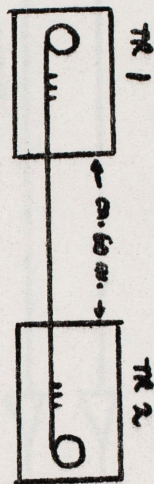
Most of the diagrammed circuits can be set up using home equipment, provided that the tape recorders have separate record and playback heads. Four input - one output mixers for isolating the input signals are available for five dollars from Lafayette Radio (Cat. 99T 4535 mono---the stereo mixer is not recommended). All feedback loops are accomplished by external patching.

A very flexible and interesting studio and performance tape recorder could be designed with the following considerations:

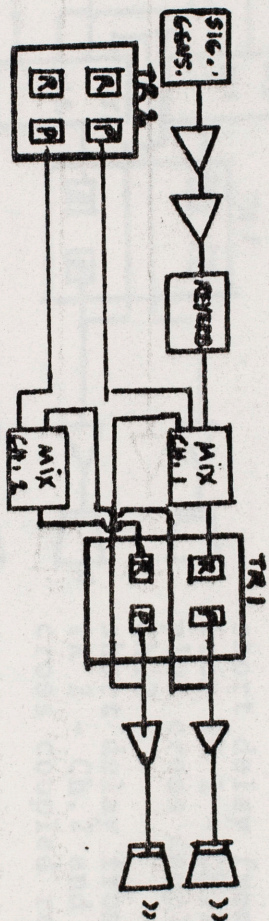
1. Simultaneous access to each head via output jacks which bypass the comparison switch (input/repro).
2. An erase head defeat switch (This provides a useful overlay function even though the record head erases the previous signal somewhat, especially the high frequencies).

3. Selective synchronization (record head can be switched to playback head).
4. Noiseless switching from record to playback mode, erase or no erase without stopping the tape transport.
5. A playback head before the erase head.
6. Extra playback heads with adjustable distance from the normal playback head for fine control of delay times.
7. Multiple channels, i.e. 4 to 8.

11
a) I OF IV - 1966

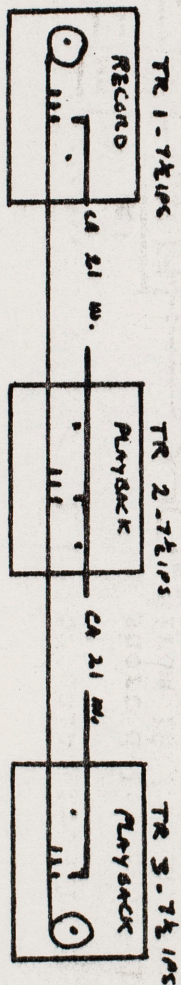


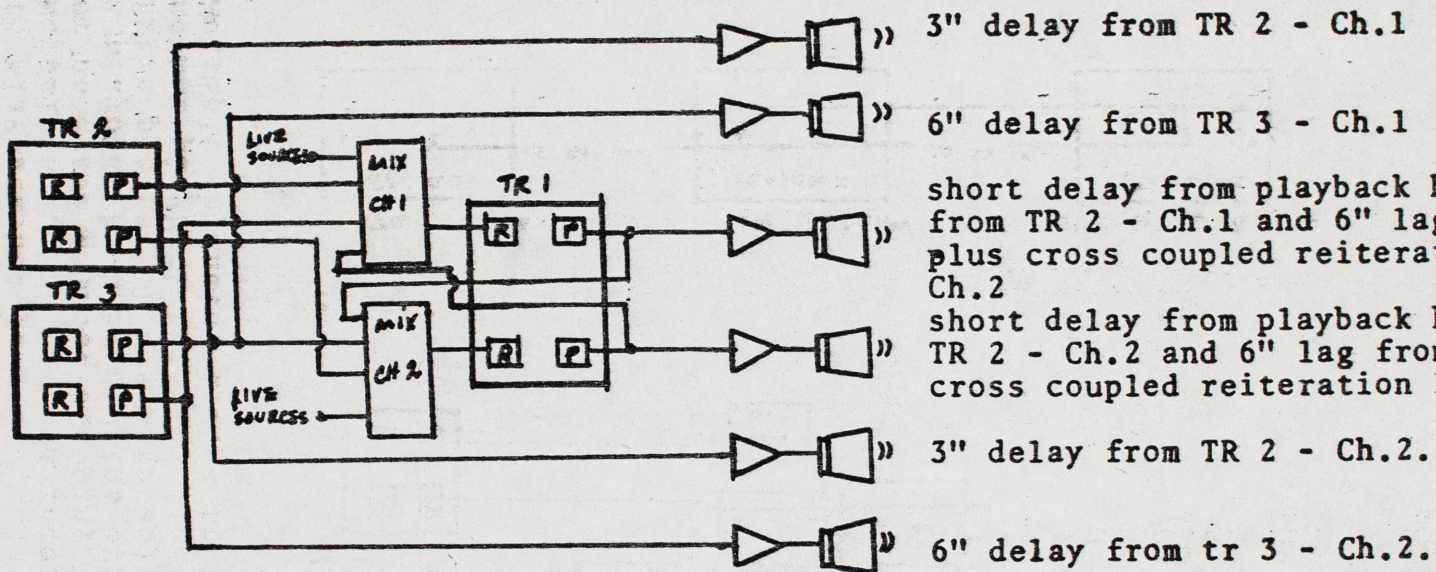
b)



Direct signal plus 8 second
 delay plus reiterative short
 delay
 short delay plus 8 second
 delay plus reiterative short
 delay

12a





3" delay from TR 2 - Ch.1

6" delay from TR 3 - Ch.1

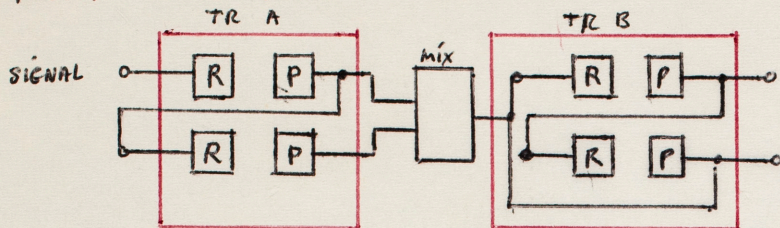
short delay from playback head plus 3" lag from TR 2 - Ch.1 and 6" lag from TR 3 - Ch.2 plus cross coupled reiteration loop from TR 1, Ch.2

short delay from playback head plus 3" lag from TR 2 - Ch.2 and 6" lag from TR 3 - Ch.2 plus cross coupled reiteration loop from TR 1 - Ch.1.

3" delay from TR 2 - Ch.2.

6" delay from tr 3 - Ch.2.

FIG. 9 LIGHT PIECE FOR DAVID TUDOR - 1965



REITERATED DELAY AT MIXER
TO REITERATIVE LOOP AT TR B
OUTPUTS

FIG. 10 BEAUTIFUL SOOP - 1967

