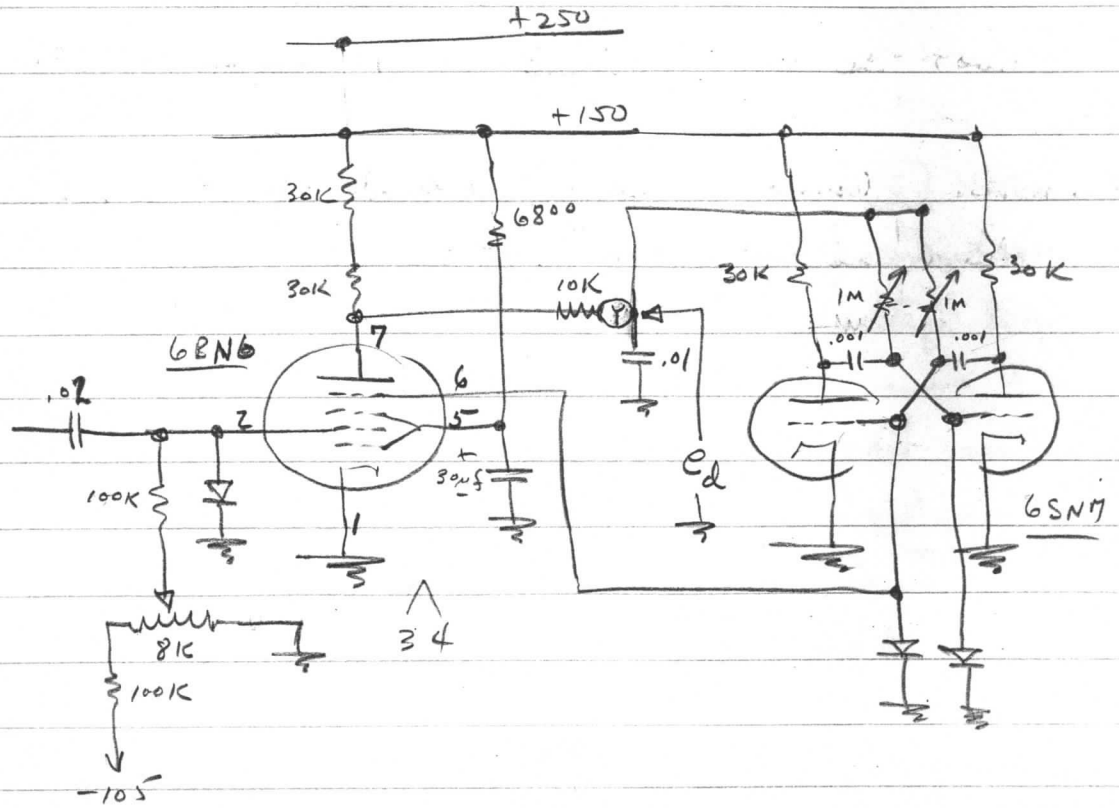
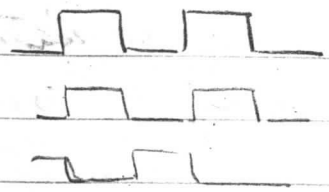
5/9/65 In the scheme of p 59 for the phase locked loop — it is apparent that the use of cathode bias lowers the + drive from the HV and reference channels instead of establishing a level for reference fading. I think this accounts for the extremely low output. If the plate of the 6BN6 were returned to +250 a swing of 100 v /180° should be realized.



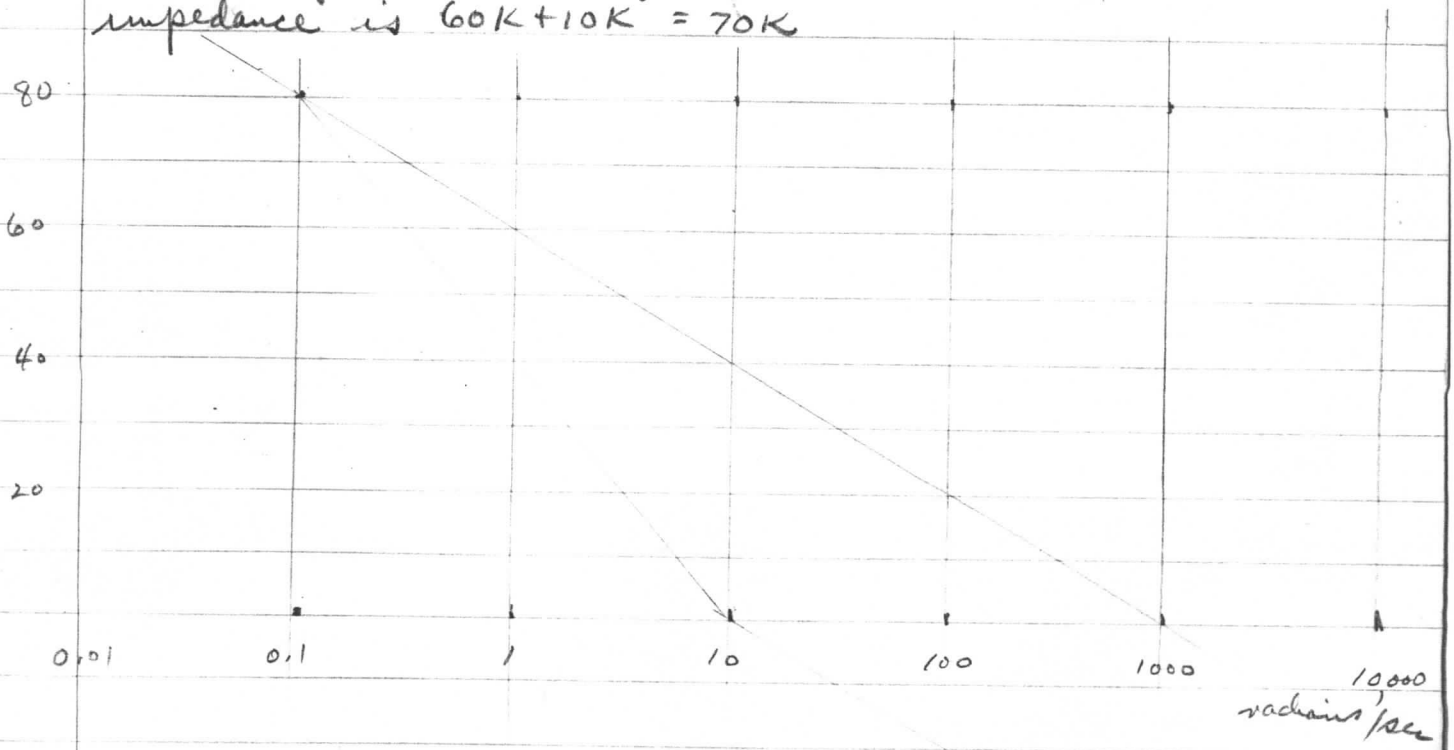
$$\frac{e_d}{\varphi} = \frac{90v - 53v}{180^\circ} = \frac{36v}{\pi} = 11.5\ ^{v}/_{radian}$$

From p89 VCO $\frac{f}{e_d} = \frac{89\ rad/sec}{volt}$



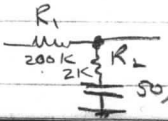
$$\text{Loop gain} = 89\ \frac{rad/sec}{volt} \times 11.5\ \frac{volt}{radian} = 1020\ /sec$$

Assuming 6BN6 has very large plate resistance, source impedance is 60K + 10K = 70K

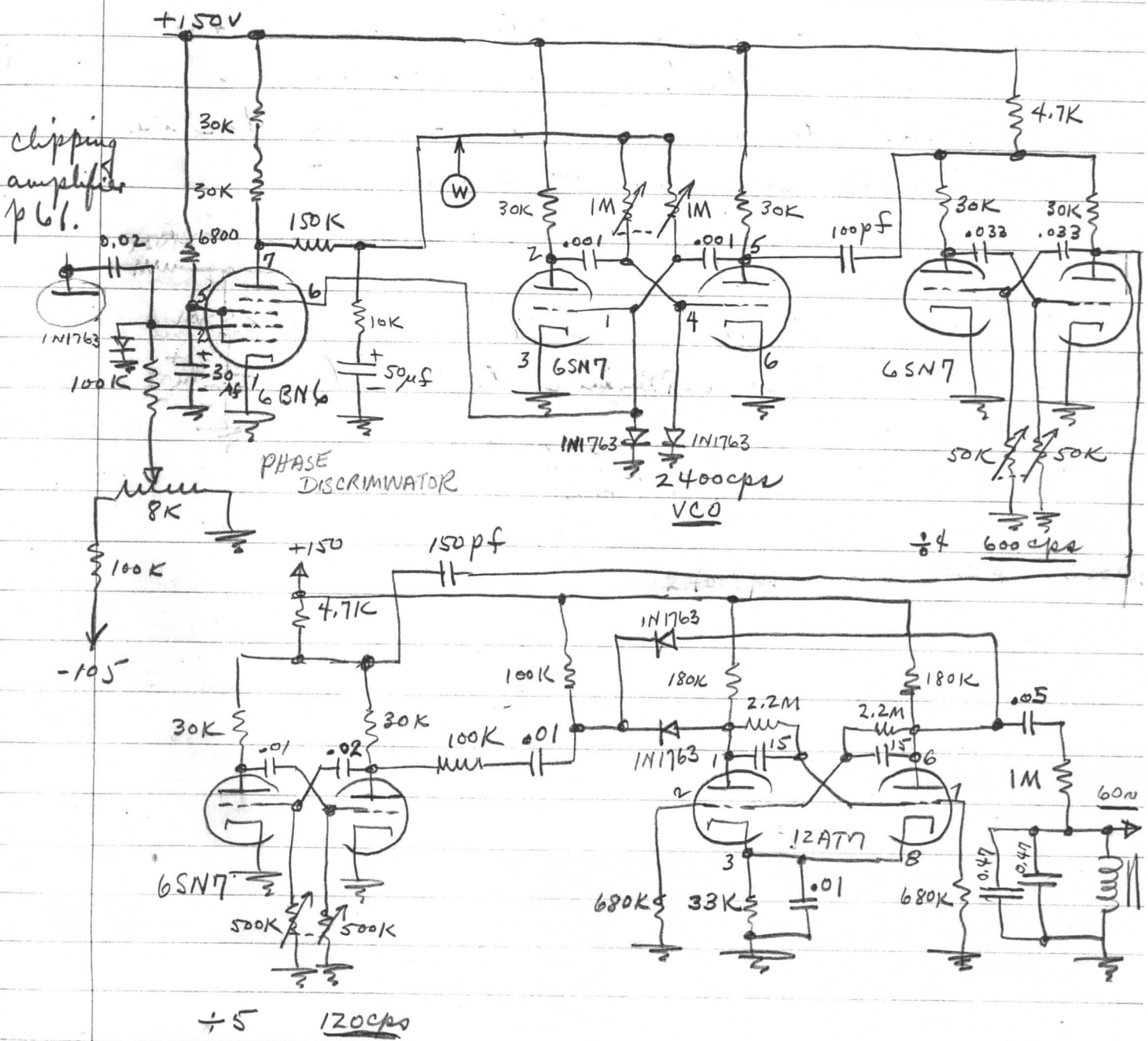


50μf R = 1 sec

$R_1 = \frac{10}{50\mu} = 200K$ $R_2 = 2K$



Adding the break networks at (Y): Internal impedance for charging (200K) is too large considering the 300K set value of the 1M dual pot. Also: it locks up on a submultiple before it charges up the 50μf capacitor to the proper value — Changed 2K to 10K because loading decreased loop gain apparently. Actually works very well — it was not adjusted properly. Set (W) +9.5V will hold on anything that can be heard in the noise. Set to be stable on noise it held very well through an entire pass from first audible tone to last — including frame bursts (not a wiggle) and several short disappearances of the signal.


+150V
clipping amplifier p 61.
30K
30K
150K
0.02
6800
1N1763
100K
30
6BN6
10K
50μf
PHASE DISCRIMINATOR
8K
100K
-10V
W
30K
1M
1M
30K
.001
.001
6SN7
1N1763
1N1763
2400cps
VCO
100pf
4.7K
30K
30K
.033
.033
6SN7
50K
50K
÷4
600cps
+150
150pf
4.7K
100K
1N1763
180K
180K
2.2M
2.2M
.05
30K
30K
.01
.02
100K
.01
1N1763
.15
.15
1M
60n
12AT7
6SN7
500K
500K
680K
33K
.01
680K
.47
.047
÷5
120cps

5/10/65 To save money on film and to use enlarger to simplify scale adjustments to match a map scale, the recorder drum diameter can be cut to 1" — Picture width will be 3.14". If I cut an 8×10" film into two 4×10's — setting picture length at 3.14" — I can get

$$\frac{10"}{3.14"/\text{frame}} = 3.2 \text{ frames}$$

This is about the length of one pass. 6:1 improvement in film cost. Will need

$$\frac{3.14"}{3.5 \text{ min}} \times \frac{24 \text{ rev}}{\text{in}} = 21.5 \text{ RPM}$$

Hurst has a 20 RPM motor — (16-20-24)

If I used the 10-32 threaded stock

$$\frac{3.14 \text{ in}}{3.5 \text{ min}} \times 32 \frac{\text{rev}}{\text{in}} = 28.8 \text{ RPM}$$ (Hurst has 25 & 30)

5/15/65 Audio oscillator p 51. I had used a 10K resistor on one 6SK7 to ground instead of 1M. Changed also to a 3w lamp but the time constants were wrong and it squegged at about 1/3 cps. Back to 6w. Recalibrated. Waveform very good now but the dual 1M pot still gives some trouble, apparently due to loose mechanical coupling (backlash) between sections and lack of precise resistance tracking.

I have made no pictures since I improved the video frequency response and built the 2400 cps countdown chain.

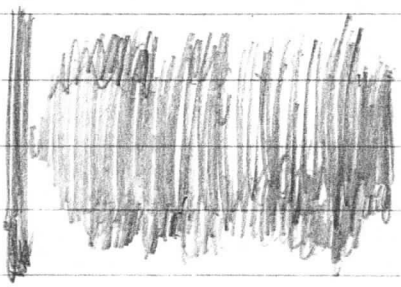
Considered changing the ÷5 stage to ÷4 and ÷6 by a switch to help in synchronizing but the run-through rate would be 1 line per second and 2/3 line per second which is too fast. Easiest might be to use a variable frequency oscillator in place of signal in phase locked loop—

Reinstalling recorder after taking it to SED Hightstown for pictures — Noted that imaged size of AR3 is .032" (see p 45) — Added small lens 7.5 mm diam 18 mm focal length ahead of eyepiece (about 1/2") and cut image size in half — $\left(\frac{6"}{800 \text{ lines}} = 0.0075"\right)$ — now have about .016"

5/17/65 Made two new negatives yesterday. Cuba and the picture after it. The phase lock held and gave extremely straight edges—

Before taking the pictures built the 4pps sweep generator again, driving from the magnetic head pickup Schmitt.

Monitoring video at (S) p61, observing position of retrace blanking pulse shows synchronism. For these pictures set blanking at beginning of trace

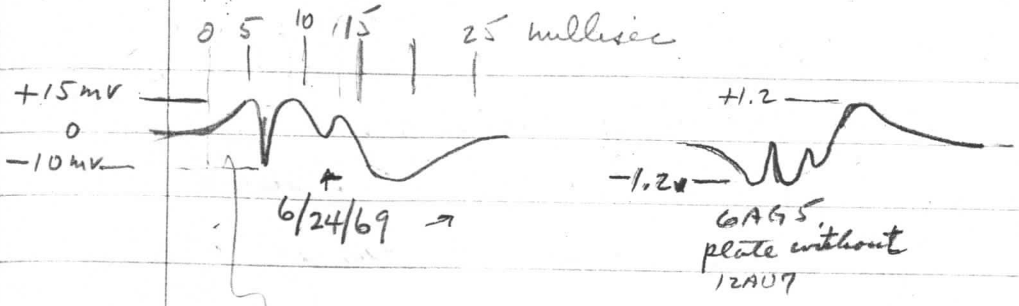


no Z axis modulation.

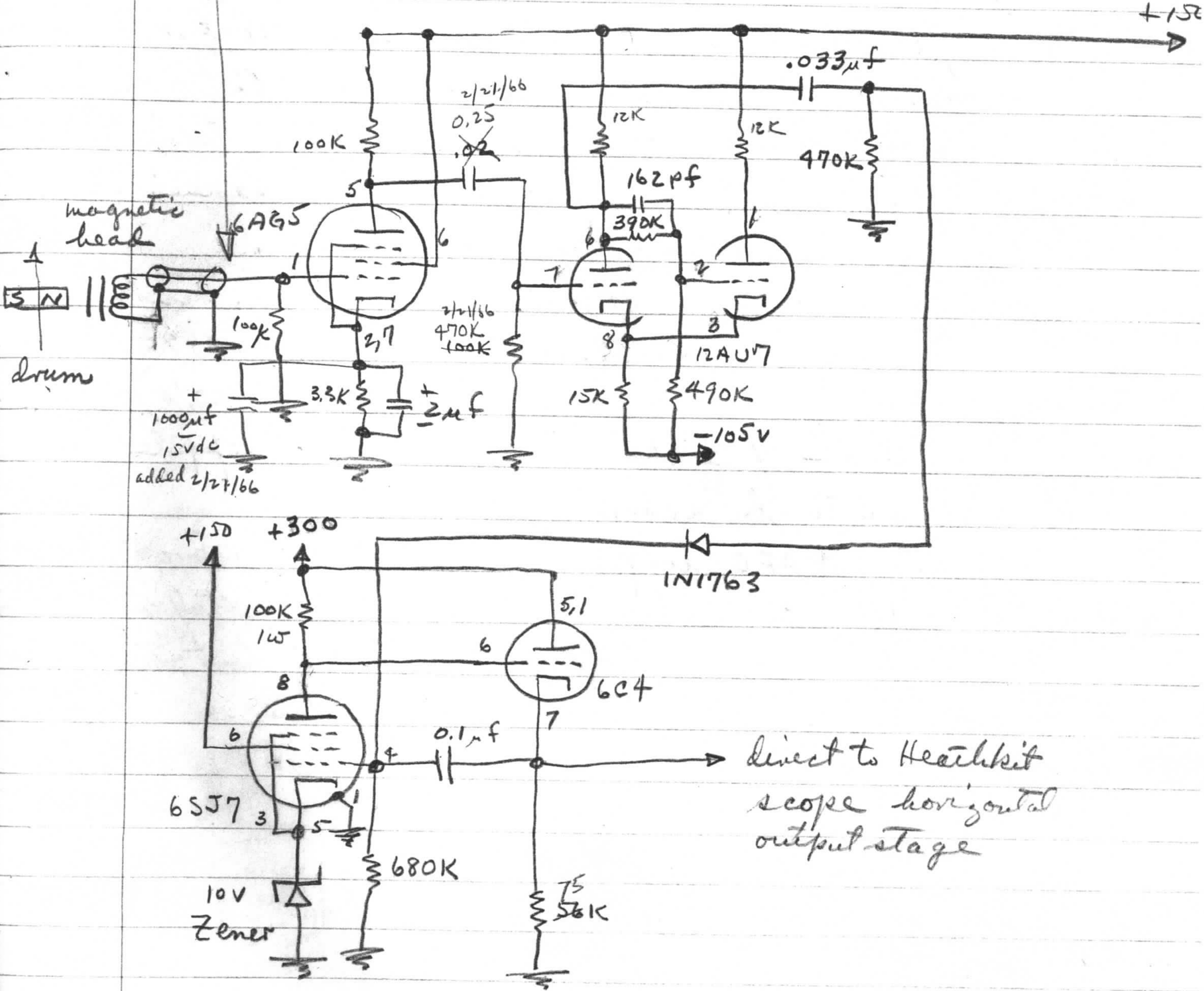
Have some 5-line grouping, and traverse is sticking occasionally & needs realignment and talcum.

See p 75 re sticking

Sweep drifts horizontally—probably poor resetting.



0 5 10 15 25 millisec
+15mv
0
-10mv
6/24/69
+1.2
-1.2v
6AG5 plate without 12AU7



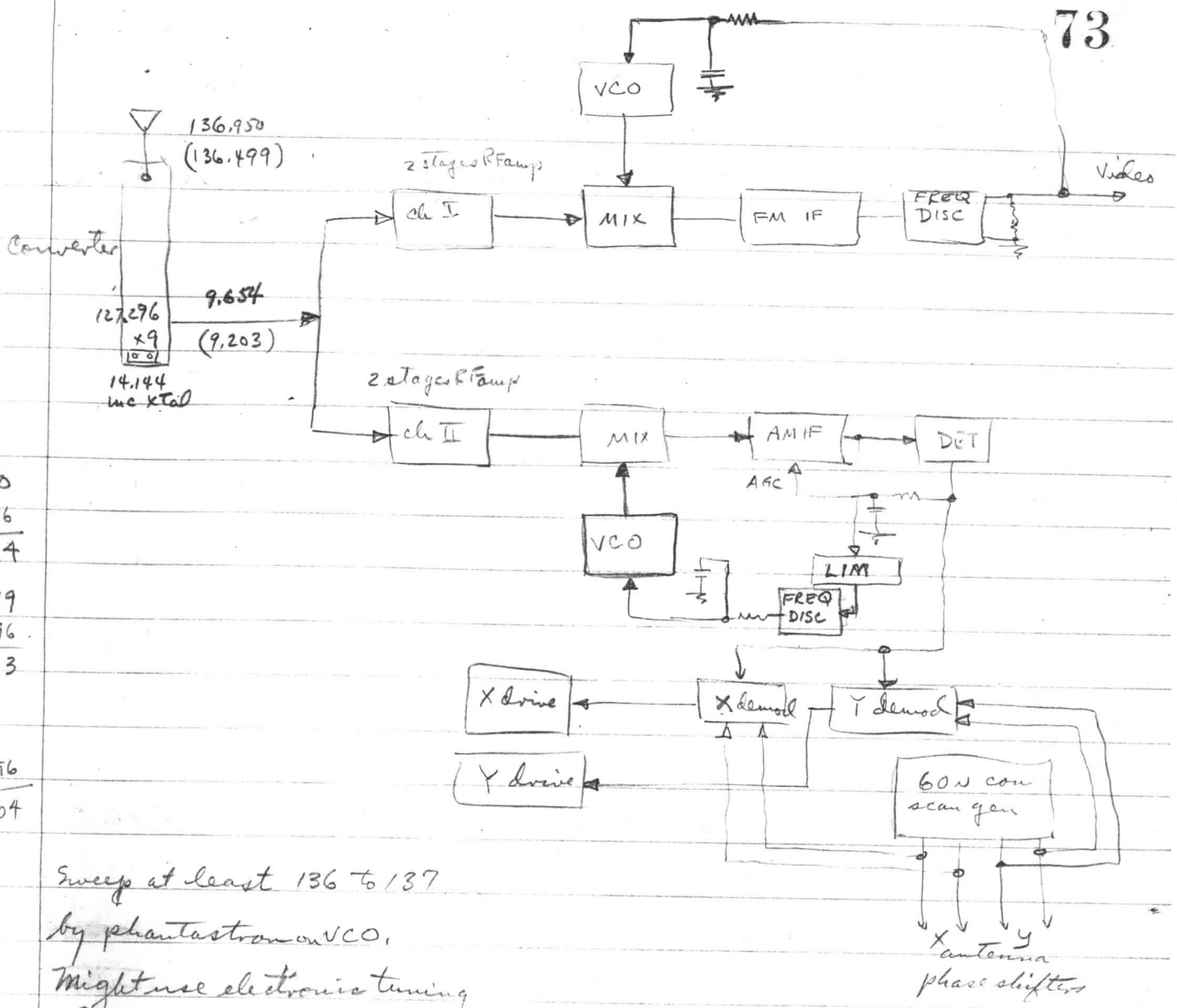
+150
.033μf
12K
12K
470K
2/21/66
0.25
.02
100K
162pf
390K
magnetic head
6AG5
S N
drum
100K
2/21/66
470K
100K
12AU7
15K
490K
-105V
3.3K
2μf
1000μf
15Vdc
added 2/21/66
+150
+300
1N1763
100K
1W
5,1
6
6C4
8
7
6
0.1μf
4
direct to Heathkit scope horizontal output stage
6SJ7
3
5
680K
10V
Zener
75
56K

136.950
136.499
.451

5/18/65 From p 56 – In considering tracking methods, I had been assuming that my FM IF would be used for signal while the normal AM IF would be used to recover the conical scan on the signal. This is not practical since the FM carries the signal out of the AM pass band. FMFB

The most elegant approach would be to track beacons and have a separate signal channel. The signals can be a megacycle apart. From the catalog of objects in orbit: The Nimbus I beacon is at 136.499 mc. 136.950 - 136.499 = 451 Kc (& can easily get into problems with 2 L.O.'s.)

Also – if 2 channels are used – Doppler will have to be accomodated on each – & could put AFC loops on each – This approach would permit my keeping my present xtal oscillator in the converter and would give independent operation and permit other converters for other bands later –



136.950
127.296
9.654

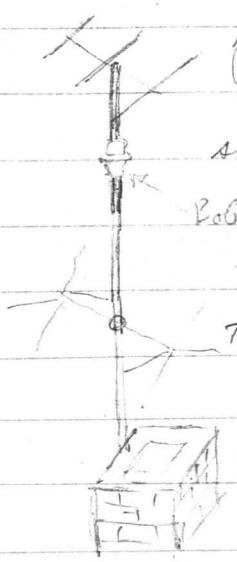
136.499
127.296
9.203

136
127.296
8.704

Sweep at least 136 to 137 by phantastron on VCO. Might use electronic tuning for manual. Set sweep width by dial selection on top of manual.

This requires RF amps to be as wide as widest sweep ~~with~~ with image rejection. Phantastron always sits off freq — could kill it by dc from disc center.

5/19/65



Installation to give signals for RF experiments. To set up the beam, I need VSWR bridge and signal source.

5/20/65 Normally I really don't need a sweep as wide as 1 mc. More like 20 kc -

If I used the 4 pps sweep generator triggered from the rolling pin, I could get some very nice post detection integration, show doppler, etc. The 3½ min sweeps might be OK for some purposes but not long enough for an orbital pass - Wonder if that motor could be pulsed to slow it down - Probably would be too load-dependent. One revolution is 5 lines.

For 20 kc sweep at 4 sweeps/sec rate is $\frac{20\text{KC}}{1/4\ \text{sec/cycle}} = 80\ \text{KC}^2/\text{sec}^2$

The rise time of a filter is about $\frac{1}{\Delta f}$ - Max sweep rate is $\frac{\Delta f}{\frac{1}{\Delta f}} = \Delta f^2$.

$\Delta f_{min} = \sqrt{80{,}000 (cps)^2} = 280 cps$

~~5/27~~

6/1/65 Ran 3 pictures yesterday - Two major developments - the 10 volt level at monitor point is in saturation enough to wash out high level detail - Cuba picture is much better at 7 volts peak-to-peak at ⑤ of p61. — Also - found that the line pairing previously attributed to irregular drive is actually due to shifting of the AR3 discharge. (p70)

Image of AR3 in 20× microscope

I reoriented the lamps to ⓓ and took 5/31/65 ⓒ (not yet developed).

I am now in a position to make a picture with the Goddard tape dub.

Goddard Tape:
Set to zero at start of noise in orbit 341

436
362
374
25

First frame 085 well modulated video
2nd frame 156 noise at 128 and end at 180
204 begins again gets noisy immediately good at 223
Cuba → Frame at 242 noisy gets better good at 301
" " 319
" " 400 noisy 468 end 471

362
387
436

Mark "orbit 342" means "end of orbit 342" apparently

Made and developed Goddard Cuba picture

6/2/65 Goddard tape signal to noise ratio is very much better. The signal also starts and stops very abruptly a few seconds from above threshold to complete dropout. They do have a few fades in odd places but their pictures are very clean.

Phase lock held through a complete fade at the start of the Cuba picture.

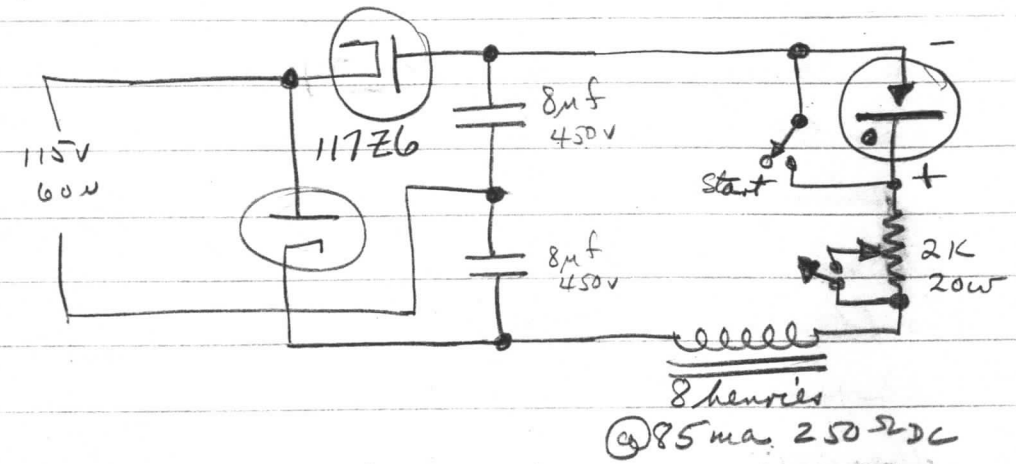
I should recheck orientation of the AR 3 - it may have slipped. The pictures show slight line pairing. Ultimately I will have to use the arc lamp to get pictures without dots where the discharge changes. Resolution will also be better probably since the AR 3 image is still too large

6/4/65 It should be possible to approximate the optimum design of RF amplifiers and multipliers using the data of pp 385-6 of Radio Engineering by Terman. The optimum conduction angle of a multiplier should follow from the order of multiplication and will be less than for a straight amplifier.

6/5/65 Electronic News reports Gemini GT4 frequencies 296.8 mc and a trial HF freq of 15.016 mc. Implication is that 2 channels near 296.8 mc are used, one for backup.

16 mc/s x vv de vcc — obs gas 28 12 and
2 8 12 and

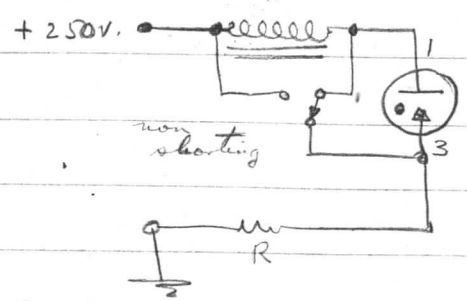
Recommended circuit from Edmund's Scientific for Zirconium Arc Lamp. Stock no 40,531



Lamp characteristics

2 watt 38 volts 55 ma, 200 volt min supply, 1000 volt minimum start. Mean light source diam = 0.005" Avg brightness 25 candles/mm^2 — Avg axial candle power = 0.3 Mean candle power per watt 0.13. Avg lumens in 90° angle 0.47 Bulb type T5 max temp °F bulb 140°F base 100°F avg life 150 hrs. Color temperature 3200°K

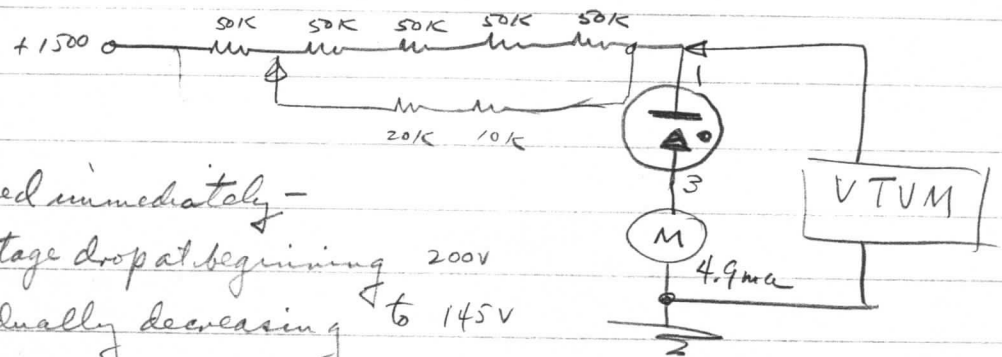
Base pin #1 positive
pin #2 no connection
pin #3 negative



Say 10ma R = 25K 2.5watts.

6/8/65 Using a variety of chokes and running the stored current up to 60ma was not able to strike the arc. I used a relay to break the circuit. Measuring on the scope, I never got above 1,000 volts. Next approach should be to use HV supply from Xmtr.

6/13/65 Using the transmitter supply + 1500V at no load



Fired immediately -
voltage drop at beginning 200V
gradually decreasing to 145V
after 10 min.

Also fires with 300K across lamp - indicating a 750V threshold. This was measured immediately after 15 mins of operation (1140 AM)

The current through the lamp and voltage across when fired are apparently related as a negative resistance - voltage across lamps goes up when supply is turned off - 45 min later still fires w/ 300K in parallel.

The stability of the discharge seems to be quite poor. Hysteresis is readily apparent - Repeatability problems are evident. Apparently the discharge generates considerable RF — can pull a 1/4" pale blue arc in the resistor network - Tried bypass with .01 and 1K and .01 and 100Ω but can still pull arc. Perhaps slightly more stable but cannot be sure.