RF Book

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RF Note #39

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## Control of the RF Systems: First Ideas

### Definition

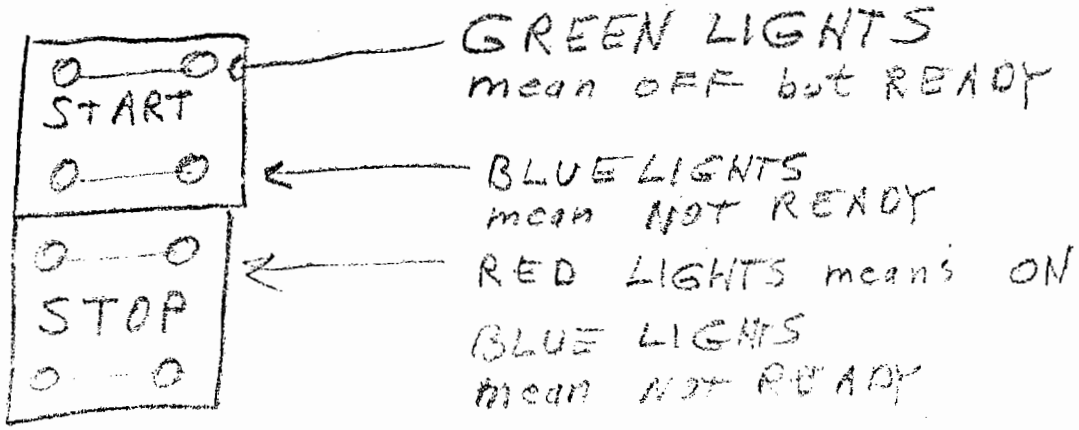
Control encompases the turning on and off of switches, either manually or automatically, protection of components where needed, provision for manual adjustment of various analog functions, regulaton of certain parameters and convenient display of conditions.

### Aside Comment

At first glance it seems that this is an exciting and interesting challenge to the systems engineer. Oh, such a pleasure to build controls that he likes, that tell him what he wants to know, that give him an opportunity to display originality and enjoy creating an artform! But then he realizes he most control himself first, and conform to various restraints.

### Restraints

The most important restraint is that the control scheme meet with at least the tacit approval of the powers that be! And then , in the long run, the controls are for operators, not designers. And then, they must not be too expensive. To meet the first and second restraint here at MSU it seems that we should use a switch and display arrangement presently in use on the existing cyclotron. This system employs dual push button lighted switches as illustrated below.



If the green lights are the only ones on on the upper switch (none should be on the lower) , then pushing the upper switch turns this item on and the red lights come on on the lower switch light if everything is doing as it should. Presumably there is a label under this switch stating what is being turned on or off. Then, elsewhere, there are status lights have the significance:

Red = ON
Green = OFF, but ready to be ON
Blue = tripped

Well, I suppose operators can get used to these arbitrary meanings, but let's not hire a color blind operator. I have a neighbor in Arkansas who grows tomatoes for sale wholesale and he has to hire others to pick them because he is color blind and can't tell the difference between a red and a green tomato. But if we have such a person on the cyclotron staff, we can make him be a computer programmer instead of an operator, I suppose.

A second problem with this system is that if both parallel lights burn out one is stumped for information. However I am informed that bi-monthly inspection and maintenance can take care of this problem! Good. So this problem does not exist! We therefore proceed.

1. Interlocking

Things like overcurrent relays, water flow switches, air flow switches, etc. will be taken care of by W. Johnson's "little" control computers.

2. Control elements of the rf system.

First, there is the synthesizer feeding the up down circuit and producing the some 100 or so outputs of F1, F2, F3, $\overline{F1}$, $\overline{F2}$, $\overline{F3}$, F+, $\overline{F+}$ etc. These rf signals will be at an approximate 3 Vrms level.

For each dee there will be a NIM bin containing the modules for fast shifters, amplitude servoes and phase and position servoes (8 for each)

Then there are three local status and control panels with buttons, lights and meters suitable for operating and debugging each transmitter dee independently. There will be jacks on these panels and on the modules of the three NIM bins for oscilloscope monitoring of almost everything.

Then there is the master rf control panel. All the above will be contained in a moveable relay rack with many (maybe 200) cables going to and from it.

Finally, on the operators console will be an rf panel with certain knobs, lights and meters. The above items will now be discussed in more detail. Let us start with the operators panel.

## Operators Panel

Close to the operators rf panel will be the master oscillator (synthesizer to yet be purchased), tuning knob and a digital frequency meter to read the value of $F\phi$(the master oscillator frequency is from 130 to 210 MHz, whereas $F\phi$ is from 9 to 60 MHz), so one tunes the oscillator and reads the resultant frequency! Figure 1 is a sketch of a possible operator's console RF panel. He will set the three position "phasing switch" to the desired position: 1= in phase; 2 = $3\phi$ clockwise, 3 = $3\phi$ c.c.

## RF Master Control Panel

In the upper left will be a 2 position switch labeled "local" "remote", meaning that in "remote" all control is from the operators console panel. In "local", however, all control is from this panel provided three lights labeled "A remote", "B remote", "C remote", are lighted.

## Pause

This note was started about a year ago and should have been completed then, so that there would be more time for revisions of the ideas presented herein. But then there were distractions: a vacation in Mexico, mint juleps in Georgia, crisis at MSU, and the necessity of cultivating my garden in Arkansas. So it lapsed. And now I realize I need to spend a few days, and many discussions with others to do a reasonable job of finishing it. However, this is simply a "NOTE", it doesn't have to be finished and I feel that even an unfinished note on this subject is better than none. So, because of the press of other matters, like high power testing the transmitter, I will present these nebulous thoughts on rf control with chagrin at their nebulosity, and I hope I will be forgiven.

Figure 2 shows, in questionlike format, what the RF Master Control Panel might look like. Figure 3, likewise, shows a mesmerists view of the station control panel, and Figure 4 shows what each of the three NIM bins might look like. In addition there is a fourth NIM bin called DEE BIN (see Figure 5), a fifth which contains the fast trip circuits and overcurrent logic circuits for the various power supplies, and a sixth and seventh which house the special purpose frequency generating circuits.

No doubt, a small army of electronics engineers and technicians can manage to build and debug all this in a few months.

So we present these nascent ideas to illicit feedback. Hopefully someone will tell me how to simplify everything so that it can all be done.

Turn on sequence

Master Panel

Phasing
1. in phase
2. 3$\phi$ CW
3. 3$\phi$ CCW

Turn on sequence.

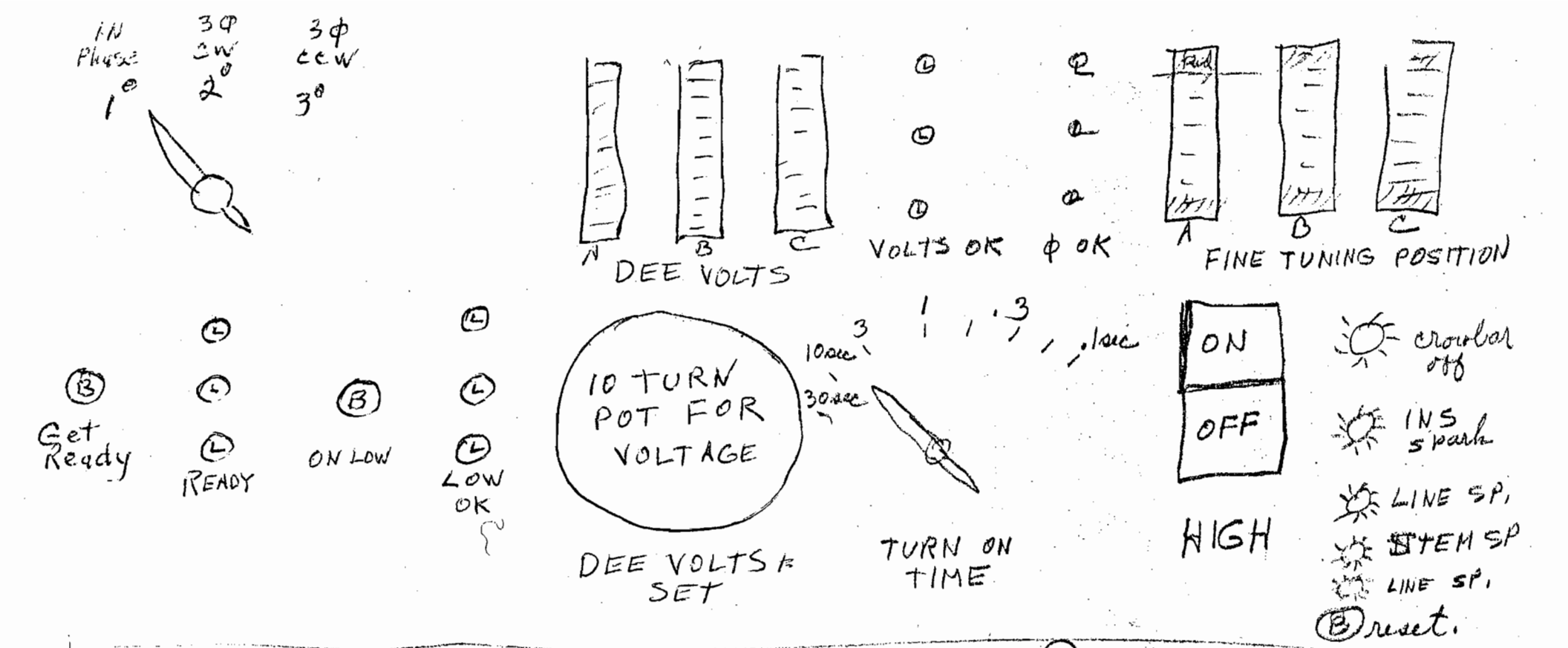
Push "get ready" -> a light for each trans. will come on showing that each transmitter has turned on up to the application of screen voltage to the driver.

Push "ON LOW". Each dee should have 100 V of rf 3 lights come on indicating that phase loops are satisfied.

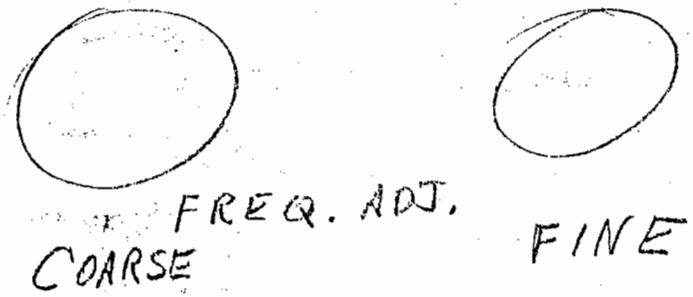
Set D Volts

Push "pulse ON". Dees will be pulsed to full voltage 1 MS on 100 MS off. (1% duty cycle). Observe 3 dee voltages on oscilloscope, noting that all patterns are identical, and that time constants for initial part of decay are right. If there is a question we will have a circuit to measure this.

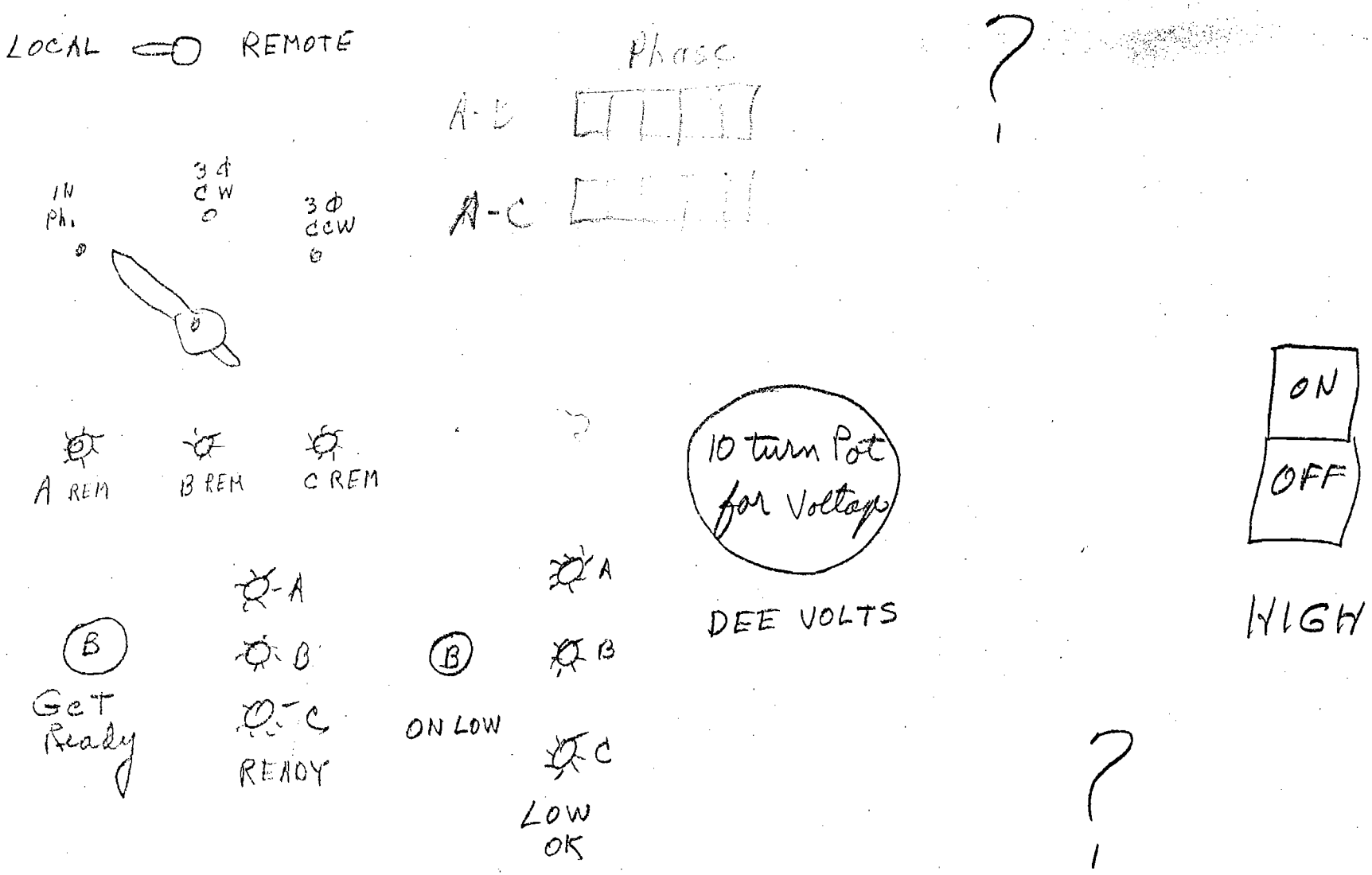
Set "turn on time" 1 to 10 seconds (T).Push "Run". Pulse width increases to T to dc.




FREQ COUNTER

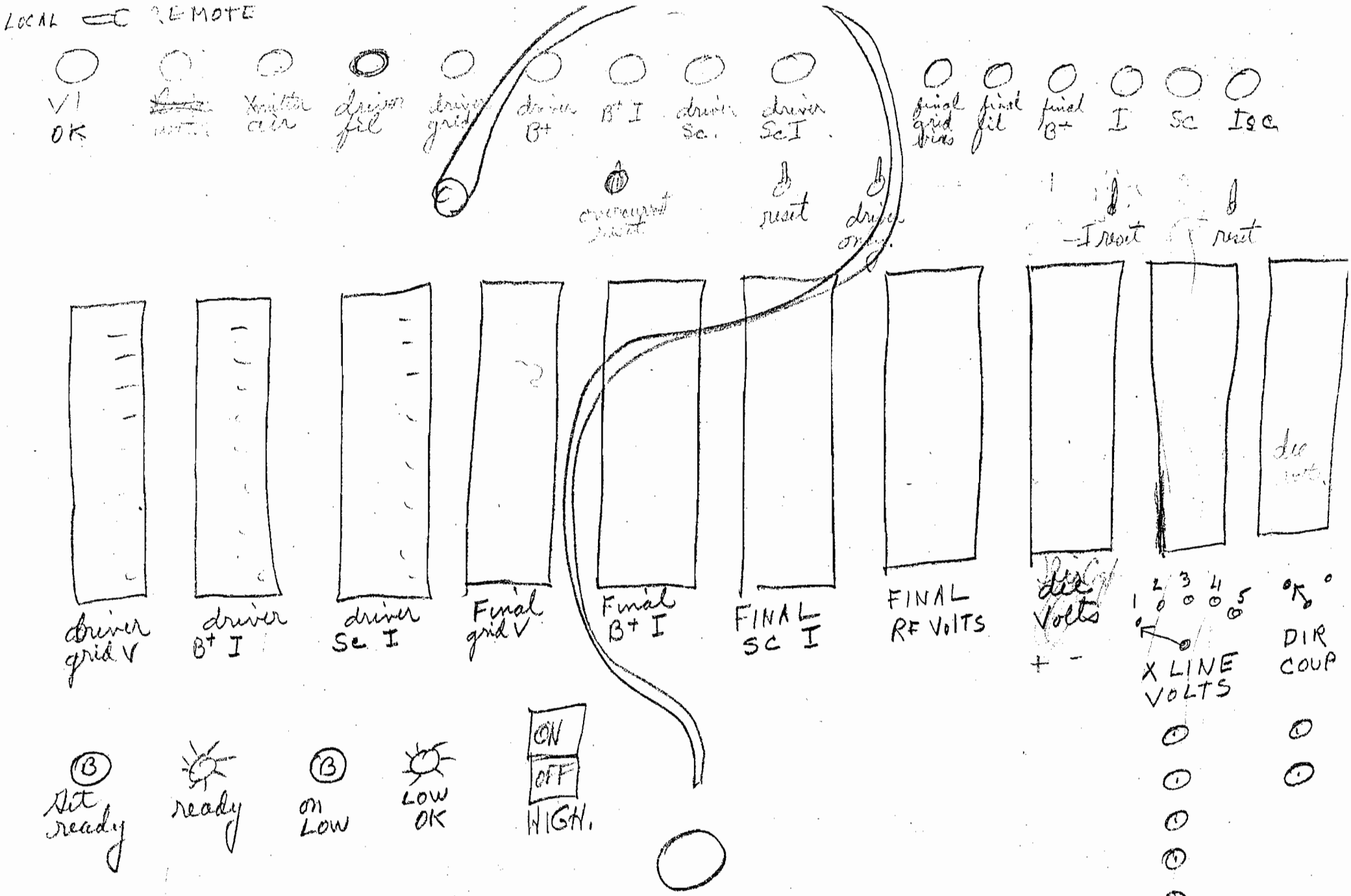



CONSOLE RF CONTROL PANEL FIG 1

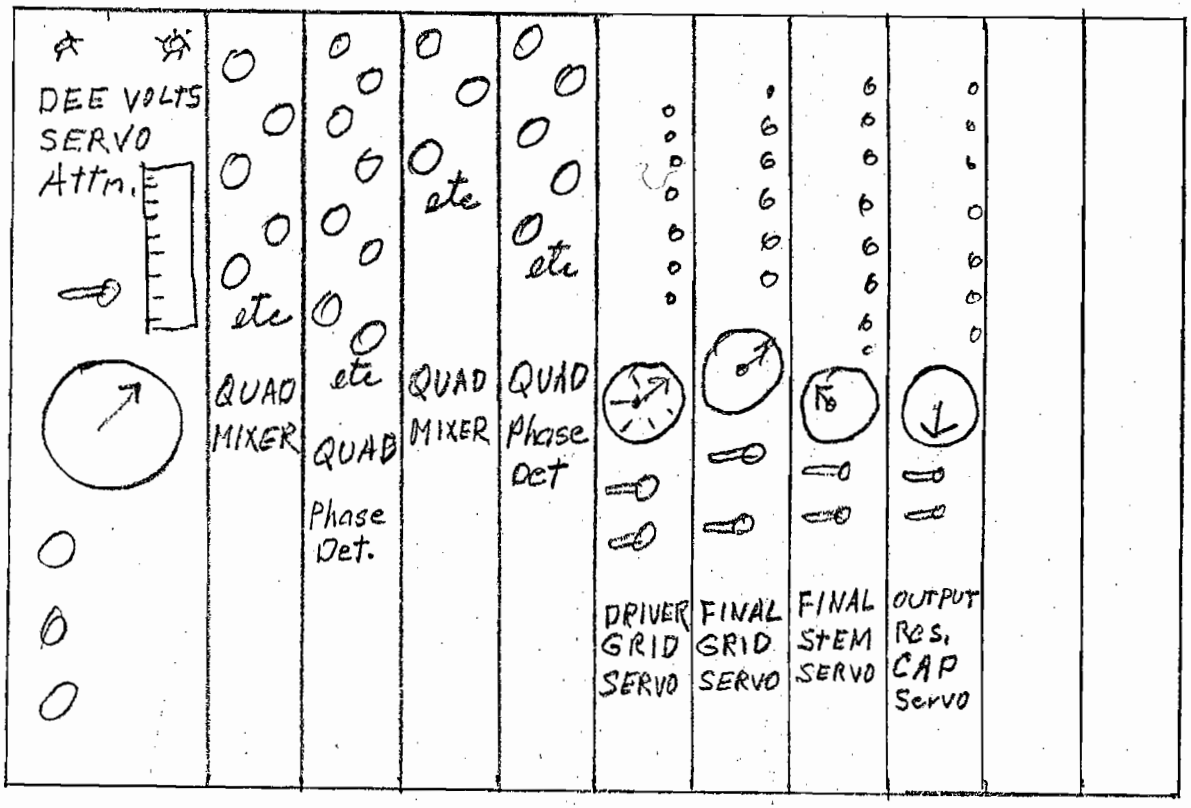



R.F. MASTER CONTROL PANEL

FIG 2.

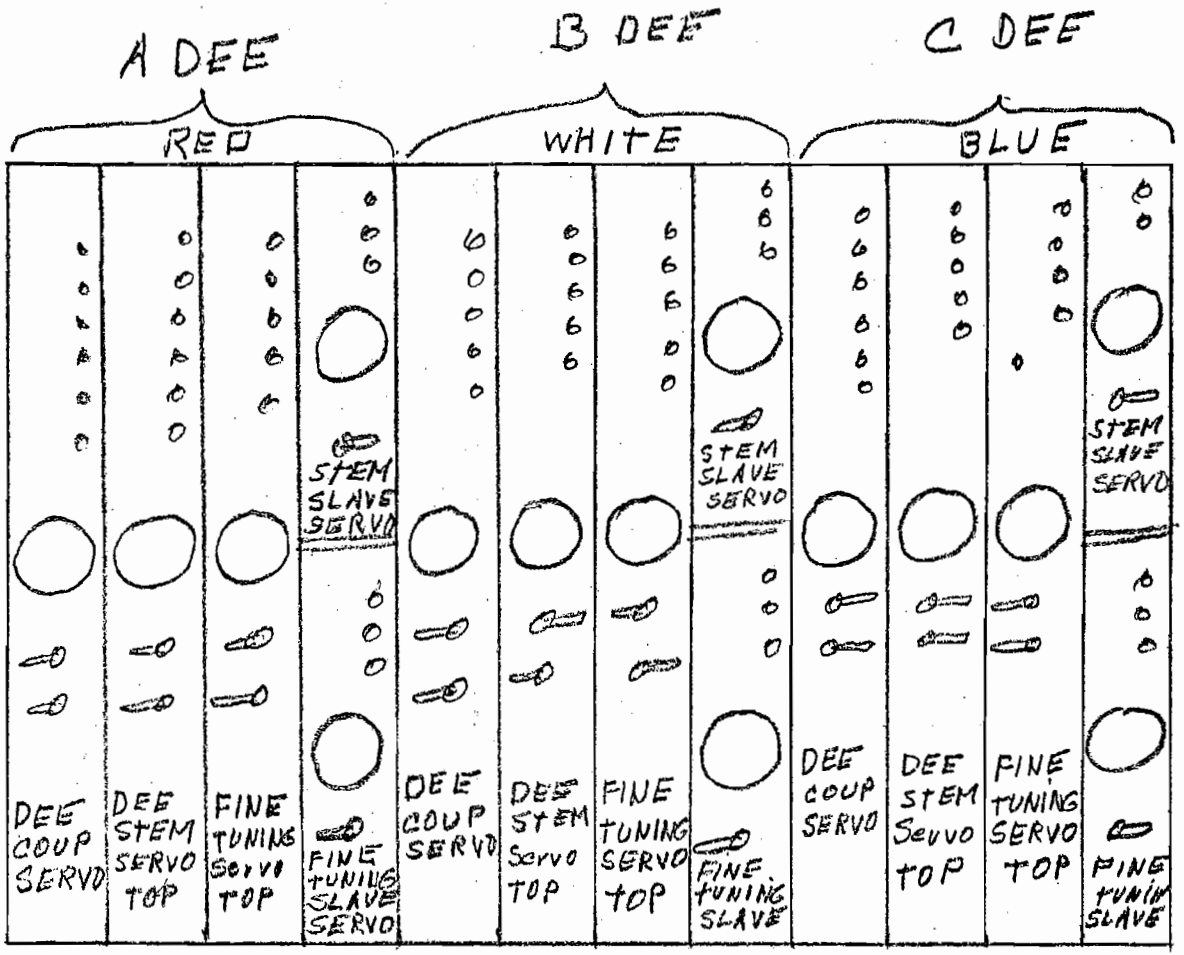



STATION CONTROL PANEL FIG. 3.




STATION NIM BIN

FIG. 4




DEE NIM BIN

FIG 5.