Pickings

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J. Riedel

1. Transmitter

By 12/5/77 a fairly acceptable assembly drawing of the transmitter existed. During 12/5 to 12/7, S. Francis made resistance paper measurements to solve Taplaces equation in two dimensions and determine the proper location and size of the output lines which penetrate the moving short. It was found easier to achieve a 75Ω than a 50 ohm solution for this geometry; therefore the transmission line from the transmitter to the dee will be 75Ω! There are several other good reasons why 75Ω is better than 50Ω, but we will not elaborate on these here. They both cost the same.

Two interesting results were determined from the resistance paper measurements. First, the current at the juncture of the hexagonal walls was down by a factor of 5 from their midpoint which means that finger gaps there won't cause excessive currents on the last fingers. Second, the current at the midpoint was only 1/4 the current on the central conductor, so that it is reasonable to assume, since power density will be down by 1/6 from the inner conductor fingers that we can use larger fingers on the outer wall and thus have more mechanical tolerance.

Then Eimac was called to discuss the transmitting tube and it was pointed out by them that the 4CW100000D was a 20 year old design and the 4CW100000E was better in many ways. So we quickly changed our design to employ the 4CW100000E.

Program TUBE was activated, and from it we learned that 75KW could deliver a power of 75KW at 18KV B^+ with only 200 volts peak drive at an efficiency of 65%, providing the screen by-pass condenser was 1000 times the anode to screen capacity. So we decide to drive the 4CW100000E with one (1) 4CW2000A tube and drive it with a solid state 50 watt broad band amplifier, purchaseable for 2K$. And we plan to proceed with expedition to build the first transmitter and test its capabilities by using it to excite the existing cyclotron rf system. This may all happen within 4 or 5 months: x Pl maybe.

Meanwhile the site for the transmitter, whether in the vault or outside the shielding wall is undetermined until we have a measure of the magnetic field at these locations. It is believed highly undesirable to place the transmitter in an environment where the magnetic field is larger than 20 gauss.

2. Dee Stems and Insulator

A small stumbling block in our pathway to freezing the design of the insulator -- dee stem geometry manifested itself when we decided to measure the electric fields at the surfaces most suspect of causing sparking problems. With flourishing pencil we had drawn a seemingly reasonable geometry with a minimum separation of two inches between electrodes which had radii of curvature of 1/4 inch. But when, using resistance paper, and multiplying by a suitable form factor to approximately the actual 3 dimensional situation, we found that the peak fields were 125 KV/inch, whereas sparking occurs at 72 KV/inch; we gulped, turned a little green, and went out for a martini. After sober reflection we experimented (using the resistive paper technique) with modifying the geometry to reduce the peak fields. But without making the separation between electrodes larger, only 10% improvement could be realized.

So we enlarged the outer diameter by two inches, thus changing the average gap from 2 to 3 inches, and after optimizing the geometry, found that the peak fields were about 80 KV/inch (all this normalized to a 100 KV potential across the gap). So it seemed that we could hold about 85 KV at the insulator, which voltage we would have at 15 MHz and 100 KV on the dees.

However, a ray of light appeared. Because the silver paint was not zero resistance, and did not penetrate the paper, a possible error of 10 or 20%, in a favorable direction, existed. So to sort of calibrate our measurements we have decided to model the geometry and test it using the deflector power supply of the cyclotron. These tests will be conducted during the week prior to Christmas. Meanwhile we keep our fingers crossed and hope that the existing design can be saved.

3. Dee Stems, Mechanical

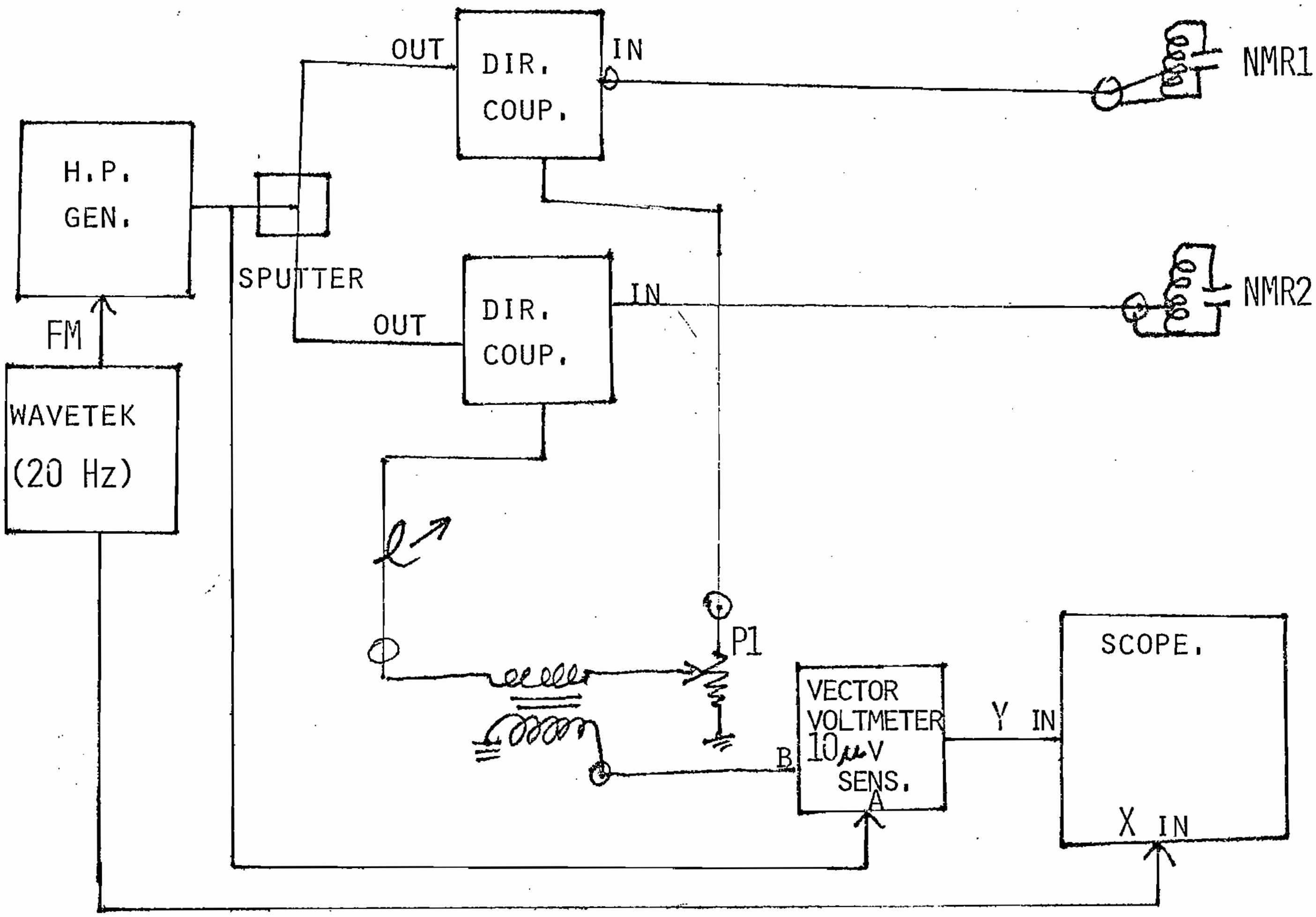
After considering various mechanical ways of constructing the outer conductor of the stems, a hexagonal configuration was finally adopted, the inscribed circle having a diameter of 14". Various complicated ways employing steel backing plates to insure flatness and straightness of the 14 ft. long surfaces on which the moving fingers of the short will wipe were abandoned in favor of simply breaking a flat piece of copper 3/16" thick and relying on it to be strong enough. A sample eight foot long piece was so bent on 12/17/77 and the results were very encouraging, so we will now go out for the mill run 14 ft. long pieces.

Meanwhile the final details of the moving short have been completed. Air pistons will permit removal of the force on the fingers while they move, so galling should not be a problem. Also, final details of the mechanisms employing bicycle chains, sprockets and a motor drive have been agreed on and these are being detailed.

4. NMR Probe

Sometime ago we decided to try to make an NMR probe to measure the 55 Kg field of the magnet, because no commercial instrument exists for these high fields. Since it isn't any fun to just copy and extrapolate from presently used NMR methods, and also because these don't work very well anyhow, we have decided to try a completely new technique, suitable for a narrow range of fields.

In this technique we will use instruments which we have on hand. The important element is a directional coupler. The ones we have on hand, when reading the reflected power in a cable have a 25 to 1 rejection of the incident power. So starting with this we propose to use a bridge technique to increase this rejection ratio to 1000 to 1. The water sample (doped with a dye to broaden resonance to 100 PPM) has a 4 turn coil wrapped around it and this is parallel resonated at 250 mHz with a variable capacitor (about 10 pf). This coil will be connected to a 50 ohm cable at a tap point on the coil in such a way as to present a 50 ohm termination to the cable at the resonant frequency of the coil. The block diagram of the rest of the circuitry is as below.



NMR1 and 2 are identical, P1 and ℓ are adjusted to give a null reading on the vector voltmeter. The "chart recorder" output of the VV (1KHz resp.) appears on the Y axis of the scope whose X axis is the triangular wave form of the wavetek osc. The Q's of NMR1 & 2 are about 100, so when the 250 mHz signal is FM'd by .01% we hardly move off the peak of resonance, and since we are taking differences, we should see nothing on the scope. Now we place NMR1 in a 55 Kg field and when we sweep through the proton precession frequency, the reactive power absorbed by the protons will, hopefully, cause the reflected power to be .001 of the incident power, and this should be evident on the scope. But, of course, it may not work.

5. Schedule

Construct one transmitter, including its stem and sliding short by May 1, 1978. Test this by using it to power the existing cyclotron.

Construct one dee stem and insulator capped off in a temporary vacuum box by July 1, 1977. Use the transmitter to test the high current problems of the short and the sparking and or heating problems of the insulator before we completely commit ourselves to our present design.

Build all the electronics (low level) for protection and control necessary to accomplish the above, by May 1, 1978.

That is all.