~~Perkins~~ R.F Book

R.F. Note #62

March 5, 1980
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Screen By Pass Condenser Failure

The screen by-pass condenser failed! On disassembling it we found that it failed where one of the bolts had sharp points where the impregnating hole was. We machined all the bolts in this area and rounded the hole edges and reassembled the first of the condenser modification that permitted one to put parasitic suppressors on the outer periphery of the screen plate, and impregnated it with RTV according to Riedel's recipe. Before baking, this condenser was high-potted while the RTV was still liquid and, due to an error by the author, was mistakenly high-potted to 20 kV rather than to the 2 kV intended. It failed, but understandably so. Quickly we reassembled the original condenser, impregnated it and baked without high-potting. It works fine.

Crud

On removing the ground plate between the anode and grid box to drill and tap the holes for the parasitic suppressor condensers we found that incredible crud had built up between the mating surfaces. This crud was about 1/32" thick and effectively insulated the aluminum surfaces from each other. It was then learned that several months ago someone had spilled a bottle of stay clean, an acid soldering flux, in the grid box. This presumably was the cause of the crud mentioned in RF Note #56. The crud was removed and the box reassembled, the author feeling that now he understood why the parasitic problems discussed in RF Note #56 suddenly manifested themselves.

Rubber Band Finger Fixer

We endeavered to achieve 100 kV at 14 MHz, but at about 90 kV we started to get air sparks at the vacuum insulators. Well, we knew the design was marginal here and that we would probably have to go to an SF6 environment. So we moved to 28 MHz and between 90 and 100 kV got many spark indications from our optical spark monitors. On pulling panels on the upper stem and inspecting the short we found most of the fingers on the inner conductor were burned up. We replaced the fingers and reassembled, and now having more confidence in our spark detectors, after only a few spark events on the upper panel we again removed the carriage and carefully inspected the fingers. Three fingers were not making good

contact, and through a microscope one could see craters on them. Our think tank proposed various solutions, the most obvious one being to abandon the fingers and go to our door spring design.

However, before abandoning the fingers I proposed one last try: put a rubber band around them to increase the mechanical tolerance. So we cut 1/16" x 1/16" silicone rubber strips from a sheet and wrapped it under tension twice around the fingers, securing the ends under screws. It was immediately obvious by inspection that this greatly improved the contacts, and all fingers were now making good contact. We reassembled and turned on again and very quickly got up to 100 kV with no sparking of the upper stem fingers. But now the lower stem showed sparking, so we put the same rubber band fix on it. Sparking still persisted on the lower stem-none on the upper.

The HFG Experiment

With considerable difficulty we got enough of an air tight seal on the lower stem to get enough SFG into it such that our spark plug (installed specifically to measure when HFG reached the top of the insulator) showed an increase in voltage holding ability of 50%. Then we turned R.F. on and at 100 kV got no sparks! But, it was late and the HFG6 consumption was expensive so we turned off. Next day (a Saturday), with the SF6 gone due to leaks we turned on and got lower stem sparks at 80 kV. So we had substantiated that HF6 is good. Monday we removed the lower stem panels and found that all the sparking had occured to the outer conductor on one of the panels. Measurements showed that the axial alignment was off by 1/16" and some of these outer fingers were not touching the panel. We corrected the alignment and came on again and now were able to get stable operation, in air, at 100 kV. Within a half hour dee sparking had diminished to the point where a few minutes of stable operation intervened bewteen vacuum sparks.

The Lost Parasitics

During this time, while monitoring out parasitic monitor with a gimlet eye, we successively removed two of the original 8 grid ring parasitic suppressors at a time until they were all gone. No parasitics. Let's hope the bastards stay lost!

Turn on, protection and regulation

We now use a new turn on module built by the Electronics Shop in accordance with the specifications of RF Note #53. It works fine. When we fail to turn on due to multipactoring the excessive reflected power signal turns us off after 30 μs. If the dee sparks we turn off due to both dV/dt and the excessive reflected power signal.

The optical (photosensitive transistors) detectors mounted on the stem carriages, the insulator spinning and the transmission line all worked o.k. and not only turned us off before much damage could occur, but told us where the sparking was occuring.

The new amplitude regulator module described in RF Note 55 was now ready, and without modification regulated the amplitude nicely. It is nice to report at least one happy event in the otherwise sea of troubles.

Problems with the panel fingers

On March 3, '80 we turned on about 3 p.m. and were happy to be able to run at 100 kV with no sparks anywhere. However after an hour we started getting sparks from both the upper and lower stem. If we turned off for 3 minutes then after turning on again it took a couple of minutes before sparking recommenced, further, it made no difference whether we were at 90, 100 or 110 kV. We removed the panels and found that all the sparking was to the panels. No fingers were destroyed, but about 5% were discolored (brownish), and the panels showed spark marks where these fingers were. The unmistaken conclusion is that these fingers were not making good contact, therefore they heated up and in doing so drew back from the panels (spring constant weakened) and sparking was initiated.

We can list 4 possible reasons for the phenomena.

1. Molycoat interferes with making good contact.
2. Copper oxide is the guilty party.
3. We need more pressure.
4. The fingers get too hot.

What to do?

1. Silver plate the panels?
2. Use a rubber backed bumper + pistons to push on the fingers?
3. Use silicon foam rubber bumpers to push on the fingers?
4. Use a pressurized rubber tube to push on the fingers?

Final Conclusion

Whereas we previously thought that the main problem was going to be with the inner conductor fingers, and we were prepared, if they failed again to put in a fixed location fix, we now will put in a fixed location fix for the outer fingers. We will use several glued together layers of our 1/16" silicon rubber backed by a bumper which will be adjusted by screws at a fixed location (29 MHz) to push on the fingers. The panels in this area will be cleaned of Mo S2 and polished.

In parallel we will develop a brush plating technique so that if the above fix also fails, we will plate the panels with silver in this area. And everyone will go to church and pray.