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R.F. Structure with Insulators

Up until this time, for a frequency range of 18 to 60 mHz, the rf system was conceived as being dees supported by two vertical stems some 12 ft. long with a sliding short circuit in the vacuum. This design was thought to be complete, though difficult to execute. Now it turns out that 35 mHz is adequate for the top frequency, and a structure that would permit eventual extension down to 7 mHz would be desirable. Therefore, we propose to throw out the existing design in favor of a new one described here.

Insulator

The novel feature of this design is to support the dees on a one meter stem terminating on a ceramic insulator just where the stem would come out of the iron pole face. This iron surface is one meter from the median plane. A 99% purity alumina insulator of the type used for the FNAL main ring cavities, 15" OD by 10" long, is believed to be capable of supporting an rf voltage of 100 kv at 30 mHz across it!

Advantages

The advantages of supporting the dee on insulators are manifold:

1. With only a 1 meter stem, and that stem a 6" dia. pipe, the mechanical rigidity of the dees will be great, in contrast to what it would previously have been when supported on 12 ft. long 4" dia. pipes.
2. The sliding short is out in air! It can breathe! And be easily repaired.

3. The outer diameter of the air line can be 16". Thus, with an 80 ohm line the length for low frequencies is reduced and the power as well.
4. Walking shorts (that abomination) and push rods with 12 ft. bellows are unnecessary. Glass ropes can move the short without gulping up space.
5. Water cooling to the moving short can now easily be made with coiled polyethylene tubing.
6. The air part of the structure can subsequently be modified to permit a frequency range of 7 to 22 mHz to be achieved. This latter range is suitable for the coupled cyclotrons.

Geometry

Fig. 1 shows the new geometry of a half dee and one stem, semi schematically. The figure, hopefully, replaces 10,000 words.

Calculations

J.R.'s handy dandy all purpose program MSUDS was used to calculate various things about this system. In this program various approximations are made about the electrical properties of the dees, but it is strongly felt that errors, or departure from reality are in an amendable direction, i.e., the dee capacities were over estimated, and conformity with the calculations can be achieved by increasing the actual dee capacities. So without boring anyone with the details of the calculations, we simply present the results in Table I. The column L, m is the length in meters from the bottom of the iron to the short. V_{ins},p. is the voltage in kilovolts at the insulator. Rs is in kiloohms. Everything else is obvious.

Comments

If the insulator can take it, I like it! Note that the transmitter drive scheme, and the fine tuning, is as before. The outer conductor of the air part of the stem line could well be square rather than round, as with the transmitter. This would facilitate repairs, as the square line could have removable panels.

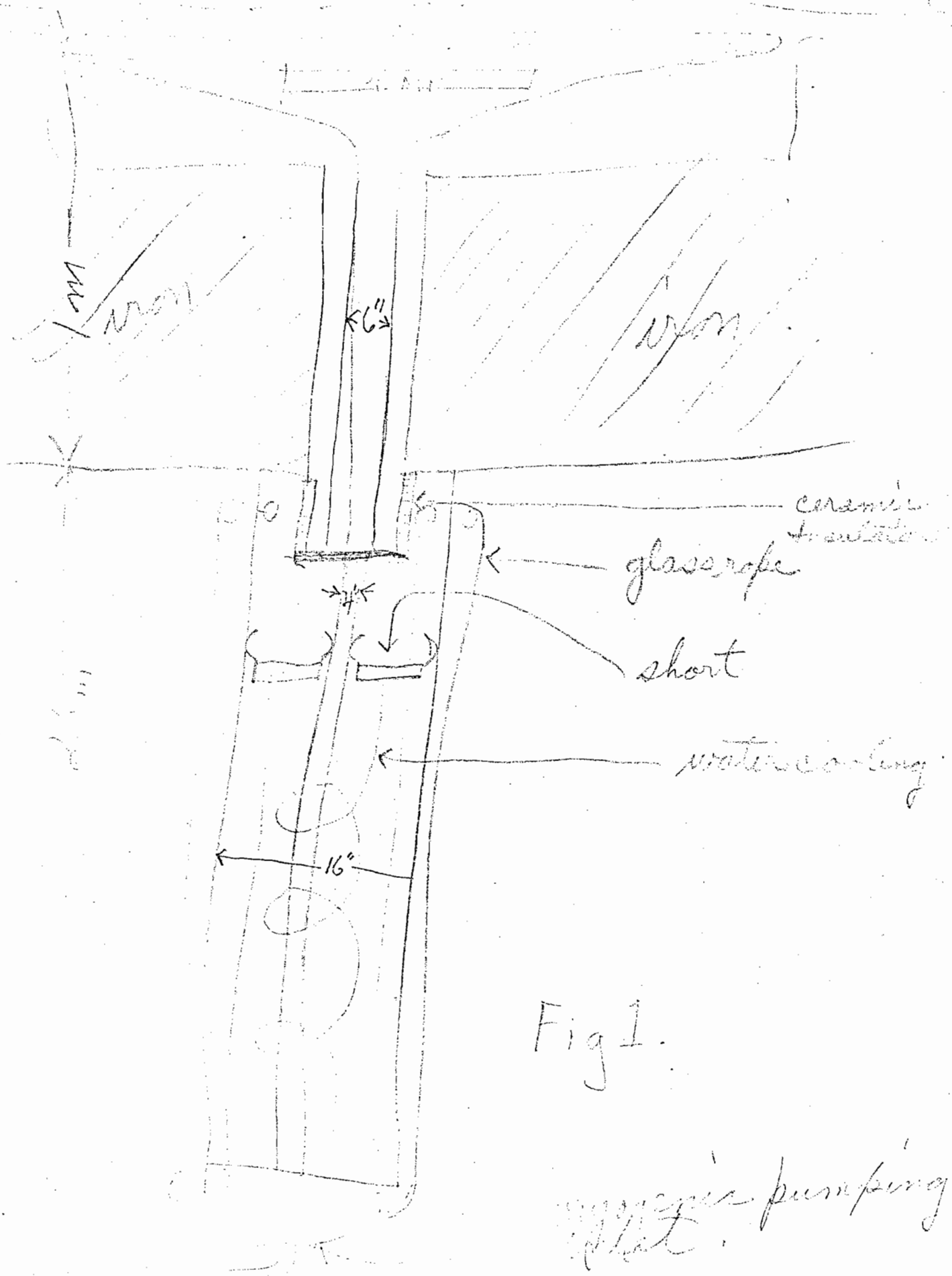

Fig 1.

oxygen pumping

Table I

FREQ	KW/dee	L,m	Q	I_{max} rms	R_s	C_{eq}	$C_{coup.}$/dee	V_{ins},p,KV
5	30	>10	3760	970	165	723	11	99
10	28	3.8	5100	1200	176	462	5.5	
15	30	1.84	5800	1400	161	381	4	87
20	34	1.01	6000	1700	144	335	3	77
25	38	.59	6000	1900	128	298	2.5	65
30	43	.35	5700	2100	114	265	2	51
35	48	.19	5300	2300	103	235	2	36
40	53	.09	4900	2300	93	207	1.8	19