

Development of a Controller for Liquid Matching Systems

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1. Introduction

Maximum RF power is transmitted from transmitter to antenna in KSTAR ICRF system when matching condition is sustained between a transmitter and an antenna. ICRF system has liquid matching systems to make a matching condition between the transmitter and the antenna. The liquid matching systems consist of a liquid stub tuner and a liquid phase shifter. The liquid matching systems contain a liquid between the inner and outer conductors of the coaxial transmission line. By changing the liquid level instead of shifting the electric short-end, the phase of the wave can be shifted based on the difference between the RF wavelength in the liquid and gas due to the different relative dielectric constants [1]. In the long pulse test on the transmission system at the high RF voltage, the reflected RF power increased with time. When the RF power was applied in absence of a feedback control at the impedance matching, the reflected RF power, P_{ref} exceeded half the forward power, P_{fw} within a few minutes and the RF voltage, V_{RF} declined consequently. On the other hand, P_{ref} could be kept at a low fraction of P_{fw} and V_{RF} was constant in the case of the feedback control [2]. We designed and fabricated liquid level controller with cylinder type stub for feedback control of the matching system.

2. Design of a Liquid line structure and Fabrication of a cylinder type stub for the liquid matching systems

The liquid matching systems consists of a liquid stub tuner and a liquid phase shifter. A schematic drawing of the liquid matching systems is shown in Figure 1.

The liquid matching systems are composed of three transmission lines which are filled liquid between inner conductor and outer conductor.

We designed a controller of the liquid matching systems which have same function and structure. A schematic drawing of the liquid line structure of one of the liquid matching systems is shown in Figure 2. A liquid matching system is composed of pump and cylinder type stub to adjust level of liquid. Low speed system, which use pump, is used to make a matching condition before RF power of transmitter is transmitted to antenna. High speed system, which use cylinder type

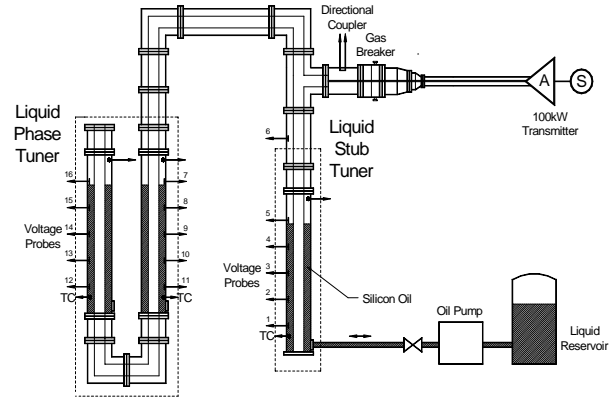


Figure 1. A schematic drawing of the liquid matching system

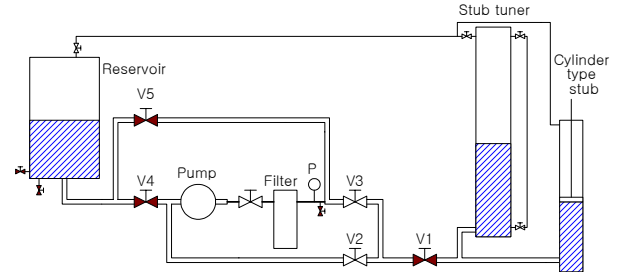


Figure 2. A schematic diagram of the liquid line structure of the liquid matching system

stub, is used to sustain matching condition during RF power is transmitted to the antenna.

Liquid is always transmitted to a liquid reservoir and/or a cylinder type stub through a filter to get rid of the trash in oil. At low speed control, liquid level in stub is raised when valve 1, valve 3 and valve 4 are opened and come down when valve 1, valve 2 and valve 5 are opened. Valve 2 and valve 3 are open at the stop status. High speed control is operated only at the stop status.

The conditions of valves for Stub tuner operation are shown in Table 1. UP means the liquid in stub tuner is moving to up and DOWN means the liquid in stub tuner is moving to down.

Cylinder type stub can control liquid level precisely and fast. It is consists of a Motor control system and cylinder tube. The test pot of the cylinder type stub was Table 1. Valve status for Stub tuner operation

Valve NO.	V1	V2	V3	V4	V5
UP	○	×	○	○	×
DOWN	○	○	×	×	○
STOP	×	○	○	×	×
Normal	NC	NO	NO	NC	NC

fabricated and tested. The speed of the motion of the liquid surface is now 4.6 mm/sec with 1:30 rated gear. It can be increased by changing the deducing gear ratio. Fabricated test pot of the cylinder type stub is shown in Figure 3.



Figure 3. Fabricated test pot of the cylinder type stub

3. Conclusion

We designed a controller for the liquid matching systems. It has two functions that one is used to match transmission line and the other is used for feedback control to match the transmission line during high power, long pulse operation. Test pot of cylinder type stub and the controller of that was designed and fabricated. The test of liquid level control by AC Motor was worked punctually. It will be installed ICRF Liquid Matching Systems and will be used to reduce the reflection power by feedback control.

REFERENCES

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