A.3: Development of pulsed demagnetizer system for high energy rare earth magnets

Pulsed demagnetizer system of 4T peak field has been developed for demagnetization of ceramic and high energy NdFeB magnets of disc shape (up to 25 mm diameter and thickness 15 mm) used in tuning of indigenous development of 7 MW Ferrite circulator for ARPF at RRCAT. The demagnetizer system is a capacitor discharge type system that generates a damped magnetic field with a peak value of about 4 T in the cylindrical fixture. Series resonant topology is used for capacitor charging. The capacitor charging power supply charges a 6 mF capacitor bank up to 1600 V.

Permanent magnets are used in biasing composite magnetic circuits of circulator for tuning in below resonance for its high power operation with low insertion loss and high isolation. To demagnetize the magnets, it has to pass through a series of decreasing minor hysteresis loops by means of damped magnetic field of changing direction. The demagnetizer system is shown in Figure A.3.1. The system consists of capacitor bank, charging electronics and solenoid demagnetizing fixture.

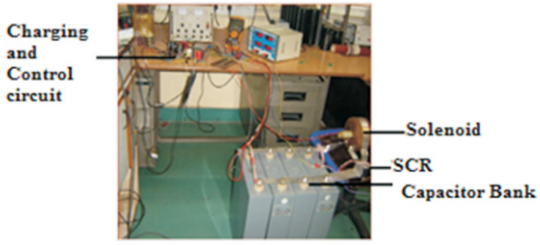

Fig. A.3.1: Pulse demagnetizer system (4 T).

The demagnetizer operates in two stages (i) store the electrostatic energy into capacitor bank (ii) the stored energy is discharged through a unidirectional switch SCR with anti-parallel diode into a magnetizing fixture. The block diagram of the scheme is shown in the Figure A.3.2.

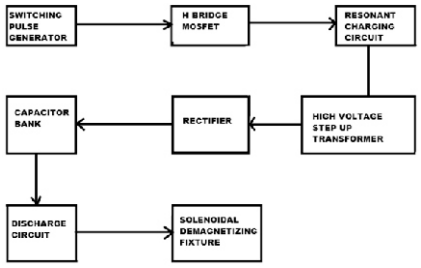

Fig. A.3.2: Block diagram of demagnetizer system.

Series resonant topology has been adapted to charge the capacitor bank, the schematic diagram is shown in Figure A.3.3. The resonant frequency of 40 kHz was chosen. An advantage of this approach is that all MOSFET switches are turned ON and OFF at zero current so that switching losses are reduced to minimum.

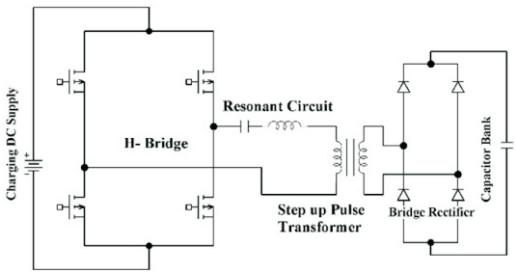

Fig. A.3.3: Schematic diagram of series resonant capacitor charging.

Output from H-bridge MOSFET then undergoes through a step up voltage transformer (1:14).The secondary rectified by full bridge rectifier and feed to capacitor bank. Thus capacitor bank is charged by constant current producing linear voltage build up across capacitor bank. Demagnetizing fixture is solenoid type. Damped sine wave with 6 ms period was chosen for full penetration of magnetic field into 25 mm disc. The demagnetizer system is successfully operating to generate 4 T peak magnetic field. The waveforms are shown in Figure A.3.4. Obtained results are presented in Table A.3.1.

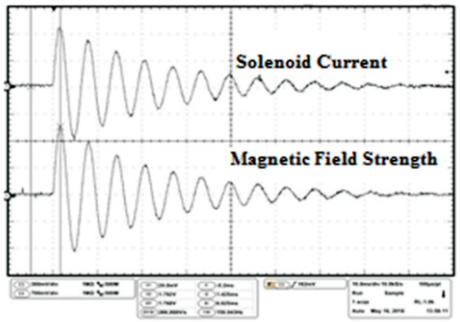

Fig. A.3.4: Magnetic field and current waveform.

Table A.3.1: Results obtained from Pulse demagnetizer system.

Peak Current	8 kA
Peak current occurrence time	1.5 ms
Peak demagnetizing Field	4 T
Inductance and Resistance of fixture	185 uH,15 mΩ
Capacitor Bank	6 mF
Capacitor voltage	1600 V

Pulse demagnetizer has been successfully developed and now is in use for tuning of magnetic circuit of indigenous ferrite circulator development at S-band.

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