AN OHMIC HEATING CIRCUIT FOR THE CASTOR TOKAMAK

M. Valovič

Institute of Plasma Physics, Czechoslovak Academy of Sciences, Pod vodárenskou věží 4, 182 11 Praha, Czechoslovakia

Received 30 August 1989

A simple ohmic heating circuit for the CASTOR tokamak is described. A test 19 kA discharge with duration of 40 ms is presented.

1. Introduction

The CASTOR tokamak is a small-size device having major and minor radii $R_0 = 0.4$ m and $a = 0.085$ m respectively. Up to now, it operated with a delay LC-line as an ohmic heating power supply. It provided discharges with stationary plasma parameters not longer than 4 ms (see e.g. [1]). This time interval is very short for the choice of optimum plasma dynamics. Longer pulses are also needed due to the limited time resolution of a number of diagnostics. Finally, larger time scale is necessary for lower-hybrid-current-drive experiments. The present work describes the simple ohmic heating circuit which prolongs the stationary phase on the CASTOR tokamak.

2. The circuit

The possible duration of the discharge on the CASTOR is limited by the half-sine-pulse length of the toroidal magnetic field (85 ms) and by volt-seconds of the iron core transformer (0.15 Vs without pre-magnetisation; see fig. 1). These parameters allow to prolong the plasma current flat-top phase to about 40 ms.

The diagram of the proposed circuit is shown in fig. 2. It belongs to the class of capacitance schemes widely used on the small tokamaks [2]. The working cycle begins by charging the condenser banks $C_1$ and $C_2$ to the different voltages $U_1$ and $U_2$ ($U_1 \gg U_2$). Firing the ignitron IG, the high voltage bank $C_1$ is discharged through the external inductance $L$ to cause the fast primary current ramp-up. During this phase, neutral gas is ionised and plasma current rises to its stationary value. When the diodes $D_1, D_2$ become open, the low voltage bank $C_2$ is discharged and the primary current increases slowly. During this period plasma current is constant. The flat-top phase is terminated using the thyristor switch $T$.

To obtain the desired plasma current waveform the circuit must fulfil certain relations which link together the values of circuit elements and characteristics of plasma loop. These formulas can be simply derived from the circuit equations.
The first important characteristic, the ramp-up rate of the loop voltage $U_L$ before the breakdown, is given by the formula:

$$
\dot{U}_L(0) = \frac{R_I M U_1}{L(L_1 + L_2)}
$$