PRELIMINARY TEST RESULTS OF BEBC SUPERCONDUCTING MAGNET

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Abstract

During the 1968 summer study on superconducting devices, the development program for this magnet has been presented and the first progress report published in the proceedings of the third conference on magnet technology. Actually the system is being put in operation and the results of the first cooling down are presented.

Main parameters

The general lay-out of the Big European Bubble Chamber (BEBC) is given in Fig. 1. The magnet surrounds the chamber which has a capacity of 35 m^3 of liquid hydrogen. Producing a central field of 3,5T, it consists of two coils inserted in two annular cryostats mounted in their own vacuum tank. The whole system is enclosed by a magnetic shield to reduce the stray field. The geometrical data of the coils are given in Fig. 2. Since the design reports, several parameters have been modified, therefore the construction parameters are recalled below.

Magnet

Rated current (A) :	5700
Axial peak field (T) :	5,1
Stored energy (MJ) :	730

S.C. Strip (NbTi)

Dimensions (mm) :	61 x 3
Filaments :	200/224
Stabilization :	CU
Overall current density (A/mm^2) :	1000
Hoop-stress (kg/mm^2) :	10
Total weight (t) :	200
CU-Resist. at 5T;4,4^{o}K;12 kg/mm^2;($10^{-8}\Omega$ x cm) :	3,5
Recovery current at 5,1T; 4,4^{o}K (A) :	7000
Critical current at 5,1T; 4,4^{o}K (A) :	7600

Recovery and critical currents have been measured on 84 short samples and the above-mentioned currents are mean values. The standard deviations are the following :

Recovery current (A) :	400
Critical current (A) :	600

Reinforcement strip

Dimensions (mm) :	60 x 2
Hoop-stress (kg/mm^2) :	20
Material :	stainless steel 304-L
$\delta_{0,2\%}$; 4,5^{o}K (kg/mm^2) :	36

Cooling strip

Dimensions (mm) :	60 x 2
Material :	CU - ETP
Cooling surface (%) :	70

Interturn insulation

Thickness (mm) :	2 x 0,2
Material :	Polyester + Polyimide
Breakdown voltage (kV) :	30

External dumping system

Voltage to earth (V) :	500
Time constant (s) :	300

Figures 3, 4, 5, 6 present interesting views taken during the manufacturing operations.

As already mentioned in previous papers eddy currents will be induced in the un-twisted conductor and produce a distortion of some ^{o}/oo on the field distribution. This avoid this disavantages, two systems have been includes in the magnet. The first one consists of an aluminium strip inserted between the windings which could be energized from an outside pulsed source. The second is made by 190 Hall probes measuring continuously the field distribution and allowing the mathematical field reconstruction.

Preliminary tests

At this stage of the general test of BEBC the magnet could be cooled down but not filled up with liquid because the delivery of the whole amount of helium was delayed. The cool-down rate was deliberately kept below the max. capabilities of the cryogenic plant in order to restrict the mechanical stresses in the sensitive parts of the cryostats to 70 % of the 0,1 % elastic limit of the stainless steel.

The stresses are due to the forces originated by the gas pressure in the cryostats (3 bars) and the differential thermal contraction between thick (180 mm) and thin (35 mm) elements of the vessels. Some typical parameters are shown in Fig. 7.

The cool down of the mass of about 330 T. requires about 260 hours.

With gas cooling the magnet has been excited up to 500 A at the rate of 400 A per hour, without recording any disturbances.

Acknowledgements

This report is the result of the work of engineers and technicians of CERN staff and outside firms engaged in the design and manufacturing of this huge magnet. The author wish to thank all co-workers for their extra special efforts in this project.

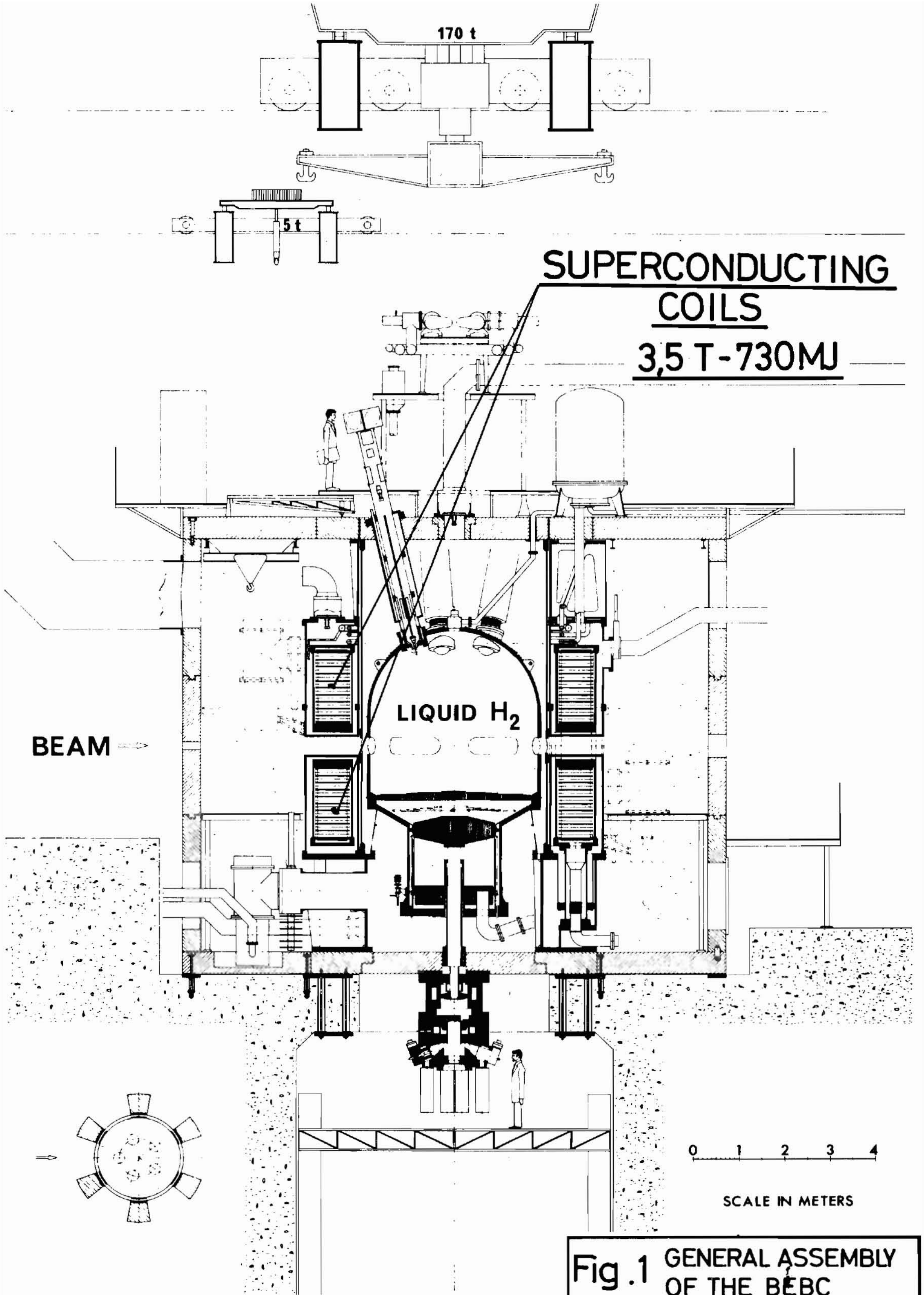

Fig.1 GENERAL ASSEMBLY OF THE BEBC

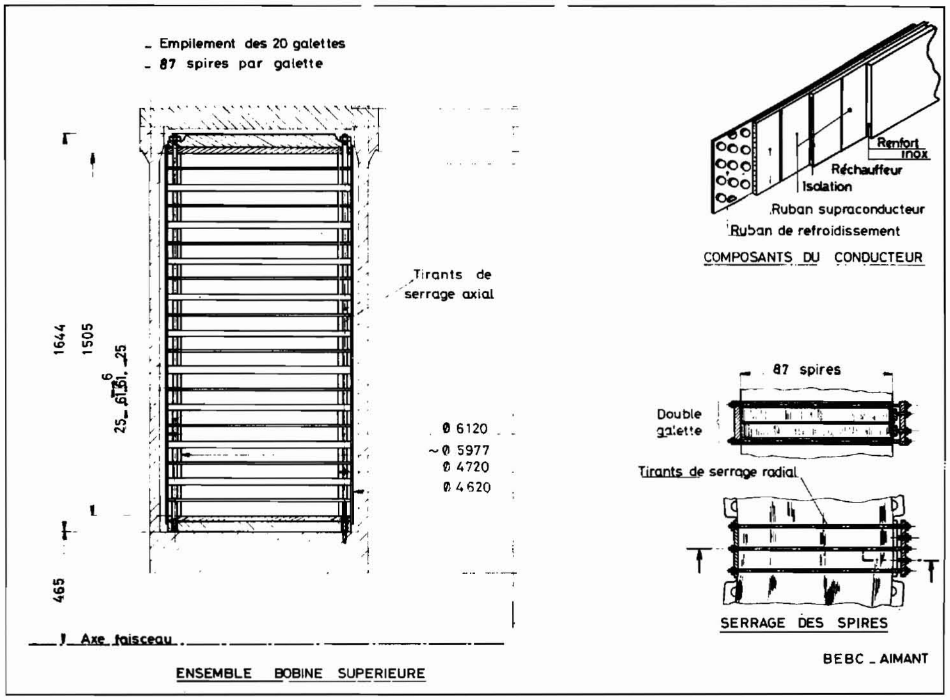

FIG.2 LAY-OUT OF THE MAGNET COIL

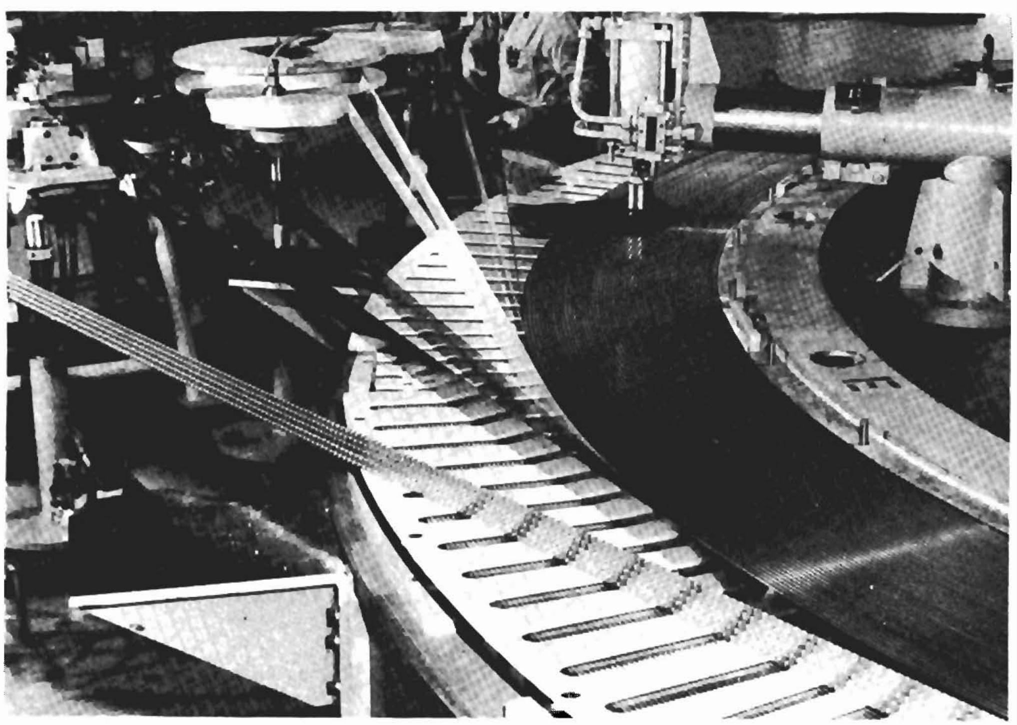

FIG.3 WINDING OF A MAGNET PANCAKE

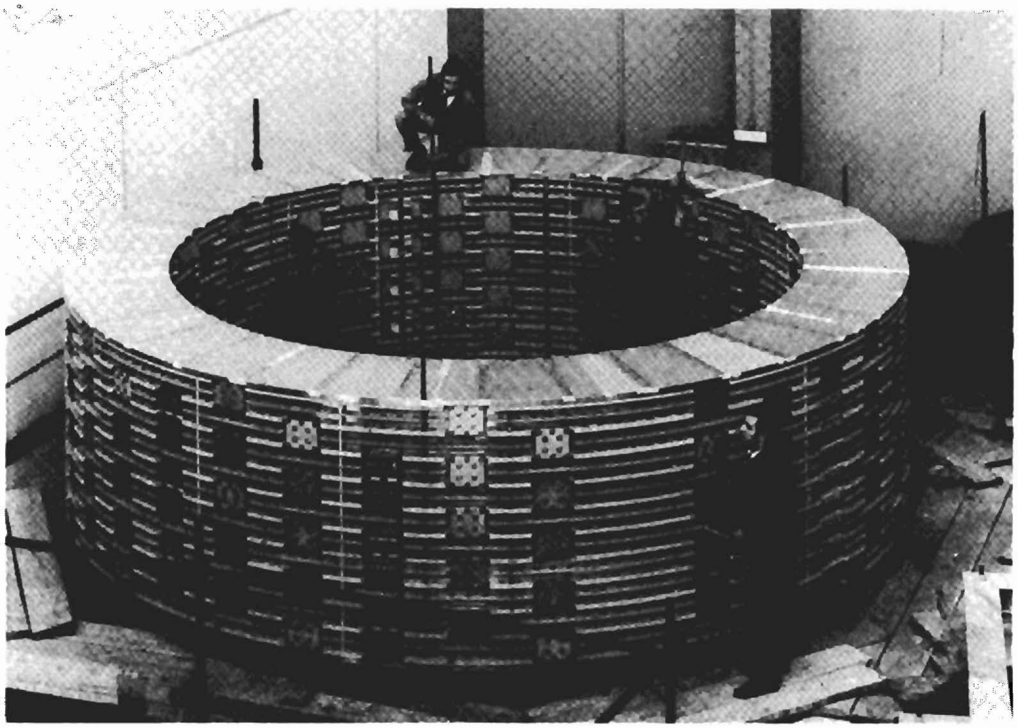

FIG.4 MAGNET COIL DURING ASSEMBLING

FIG. 5 LOWER CRYOSTAT PLACED IN THE MAGNETIC SHIELD

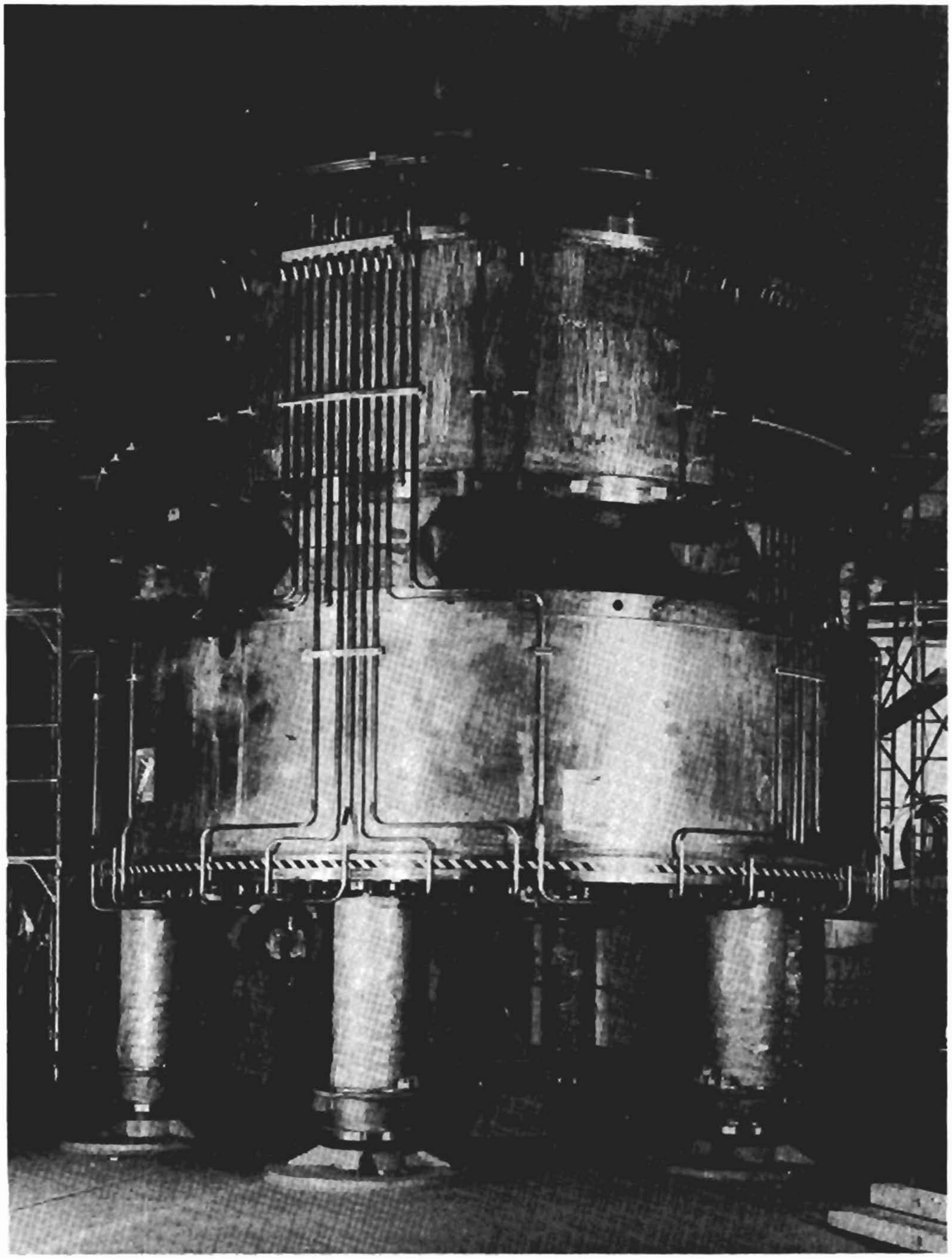

FIG. 6 ASSEMBLY OF BOTH CRYOSTATS (120 t)

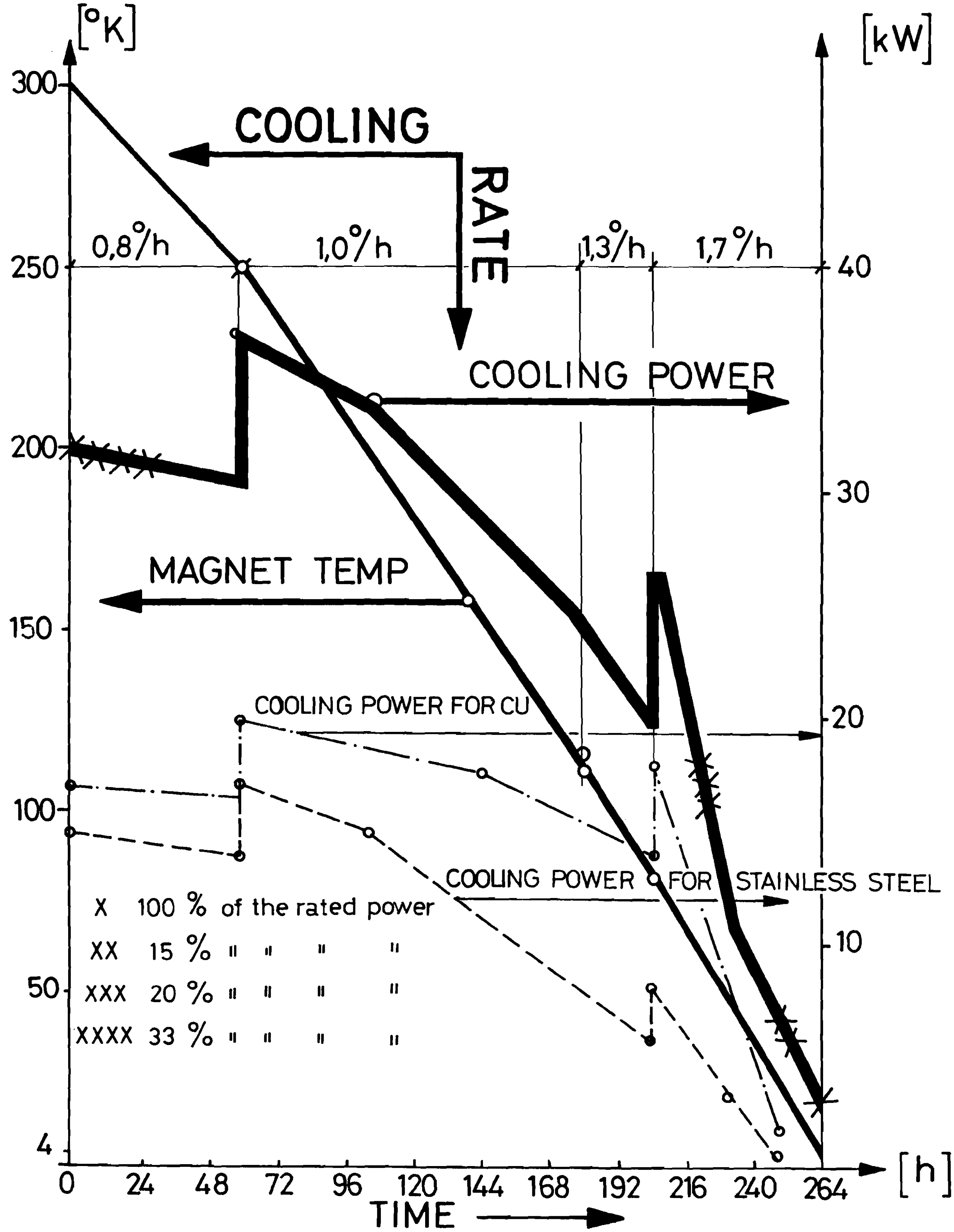

FIG.7 MAGNET COOLING PARAMETERS