MAGNETIC FIELD MEASURING SYSTEM FOR THE RIKEN SSC SECTOR MAGNETS

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Abstract

A pneumatic drive magnetic field measuring system was designed and constructed. It can cover the area over 180° of the beam orbit plane of the SSC. The magnetic field of the two sector magnets, constructed by this summer, was measured by this system.

1) Mechanism

Field mapping area necessary for the orbit calculation has a different radial range in each azimuthal zone as shown in Table 1. Hall assembly, which contains magnetic field detectors, has a radial length of 2660mm. It has to clear gap spacers, and injection and extraction elements. In order to get an accurate positionning of the Hall assembly and to make a tention of the rotating assy small, three pneumatic pistons are equipped to the rotating assy for each directions (Fig.1). Two pistons moving 5mm and 20mm in radial direction, and two for 0.25° and 1.0° in azimuth are connected in tandem, respectively. Moving time of the Hall assembly in azimuthal direction is different in each position because of the eddy current, as shown in Table 2. Accordingly, the piston control system has to know the piston's actual position by a potentiometer in each direction. Two rotary encoders (COPAL: RE-20A) and up-down counters indicate coarse position of the Hall assembly.

TABLE 1: Range and step of mapping area for 1/8 sector(45°).

ZONE	θ_i	θ_f	$\Delta\theta$	STEP	N_θ	R_i	R_f	ΔR	STEP	N_r
#1	0°	10°	10°	1°	11	810	3810	3000	20	151
#2	10°	18°	8°	1°	8	810	3770	2960	20	149
#3	18°	22°	4°	1°	4	770	3770	3000	20	151
#4	22°	26°	4°	.25°	16	690	3690	3000	20	151
#5	26°	29°	3°	.5°	6	690	3690	3000	20	151
#6	29°	45°	16°	1°	16	690	3690	3000	20	151
						mm	mm	mm	mm	

θ=0: Magnet center line, θ_i: Initial angle,
R_i=Min. radius, R_f: Max. radius.

TABLE 2: Moving time of the Hall assembly

DIRECTION	STEP	TIME
R	5mm	1sec
	20mm	1.6sec
θ	0.25°	2sec (Hill & Valley)
	0.25°	4sec (Magnet edge)
	1.0°	2.5sec (Hill & Valley)

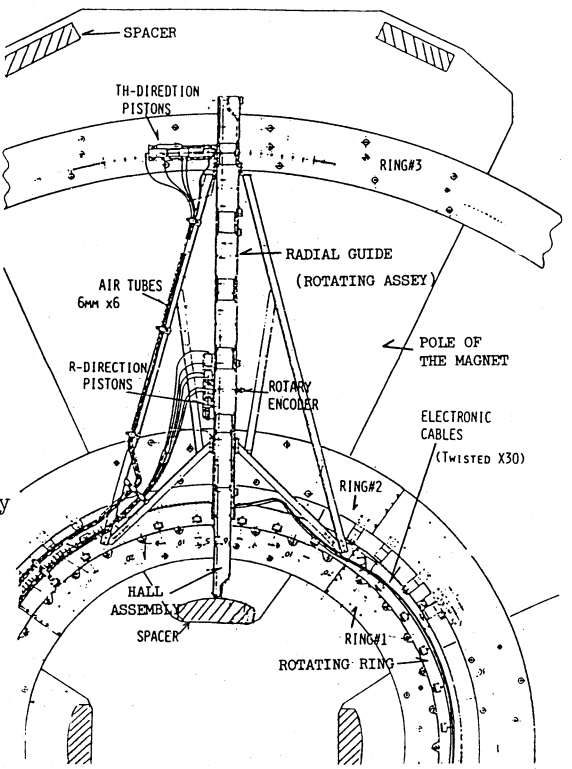

Fig.1: Plan view of the mechanical part

2) ELECTRONICS

The system is controlled by LSI-11 micro computer (Fig. 2). Twenty sets of Hall probes (SBV-601s1) are mounted radially in line with pitch of 140 mm on the Hall assembly. Their twenty outputs and other analog signals (current monitors etc.) are led to a relay scanner (FLUKE:2204A) and a D.V.M (8502A) through thirty pairs of twisted cables. Sampling time of the D.V.M had to be longer than 250 ms/channel because of noisy environment in the big factory. Reading error of the D.V.M was less than 2 μV which corresponds to 0.6 G of field. Hall control currents (200 mA) are connected in series each other and stabilized with an accuracy better than 5×10^{-5}. A digital thermometer for the Hall assembly, NMR Gaussmeter, magnet power supply and the other devices are connected to the computer via CAMAC register.

3) COMPUTER SOFTWARE

The main part of program is written in FORTRAN and the remainders, especially for CAMAC control, are written in Macro-assembly language as subroutine. The application programs are developed not only in LSI-11 terminal but also in FACOM M-200 large computer. Communication between LSI-11 and M-200 is realized using a magtape or an acoustic coupler.

At the measurement, the magnetic field is calculated using Hall calibration polynominals (5th order and one tamp. coefficient), and displayed on a digital plotter or on a colour graphic unit (OKI:IF-800). The data is recorded on an 8" floppy disk, and the disk data is copied to magtape in order to be processed in the large computer.

In order to reduce a systematic errors caused by a change of the Hall prove characteristics or by drift of some speciality, each neighbouring Hall probe can measure at the same point by moving 140 mm radially.

Total measuring time for 45° mapping area as the Table 1 was two hours and a half.

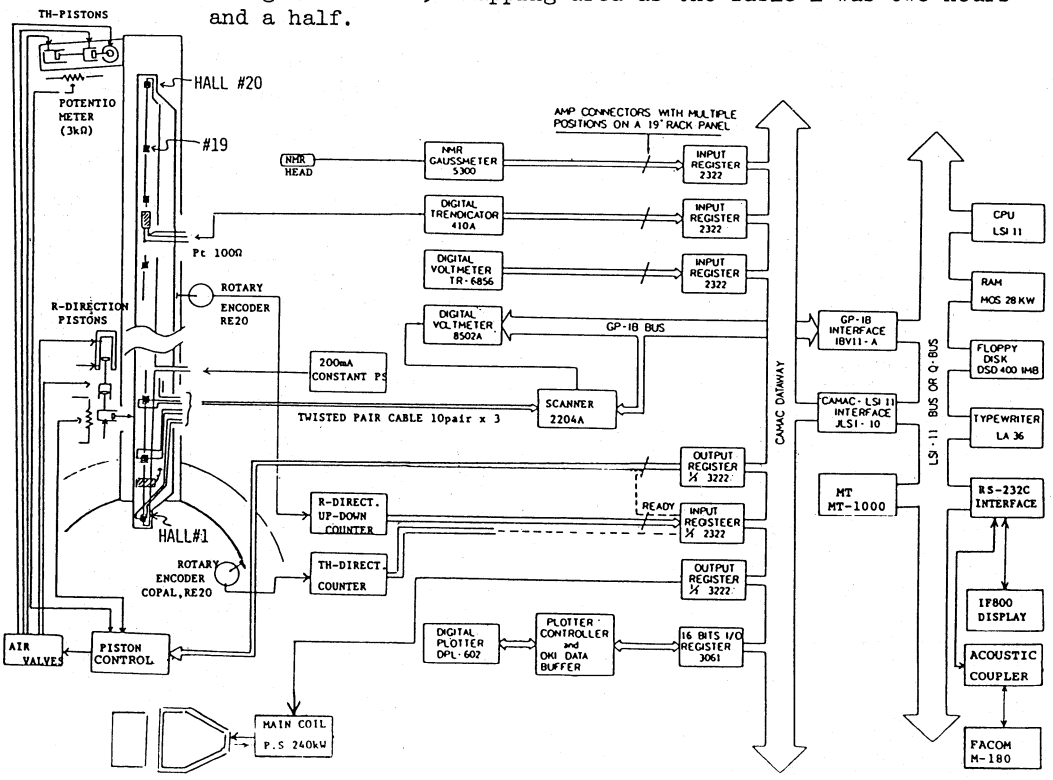

Fig.2:Schematic diagram of the magnetic field measuring system.