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FULL AUTOMATIC RADIOMETER FOR SOLAR PATROL AT 5 GHz

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A full automatic radiometer for solar patrol at 5 GHz has been successfully in operation for more than a year. It is characterized by a unique method of tracking the sun by continuously driving the polar axis in one direction.

A full automatic radiometer for solar patrol at a frequency of 5 GHz has been installed at the Kagoshima Space Center, the University of Tokyo, since August 1970. This radiometer was designed and constructed at Toyokawa Observatory, Nagoya University, which has been in operation almost satisfactorily for more than a year. Though the radiometer system is of conventional one, it is characterized by an automatic operation for years simply by feeding a roll of recorder chart every seven weeks. The automatic operation can be achieved only when the antenna always follows the sun, the sensitivity of the receiver is calibrated frequently, and the sensitivity is adjusted automatically during the burst. In addition, the antenna has to withstand severe typhoons which often attack the antenna site, and it also has to continue tracking the sun even when power supply happens to stop for several hours.

Automatic tracking of the sun The antenna with a paraboloid of 1.2 m in diameter was designed as shown in Fig. 1, which can follow the sun continuously throughout the day. It means that the polar axis rotates continuously in one direction. This mechanical structure greatly simplified the control system and also satisfied the requirement for power saving to provide against a possible unexpected interruption of power supply. Since the half-power beam width is 3.8 degrees, the pointing accuracy must be ± 0.1 degree to keep the error within 2 percent for any distribution of active regions on the solar disk. The polar axis is driven synchronously with a clock, and the pointing error thus produced is corrected by a correction motor through a differencial gear. The correction of both polar and declination axes is made twice a day, at noon and at midnight. At midnight, the correction is made so that the error will not exceed 0.1 degree during 06 to 12 L. T., and at noon, similar correction is made for 12 to 18 L. T. This approximation is possible because the maximum values to be corrected during six hours are 0.1 and 0.06 degrees for declination and polar axes respectively. The program of correction throughout the year is set on a

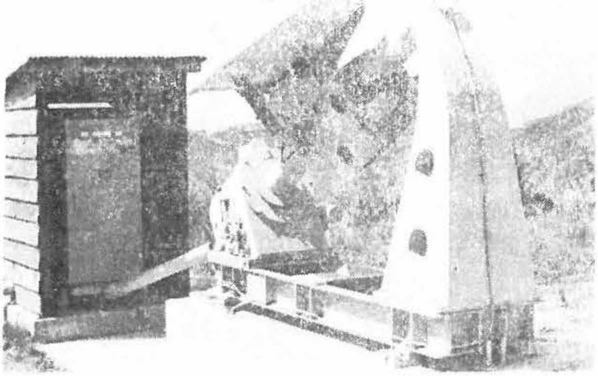

Fig. 1. General view of the antenna.

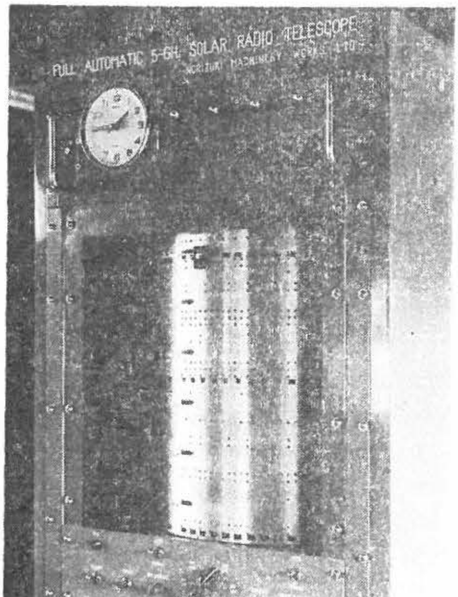

Fig. 2. Memory drum for correcting axes.

drum as shown in Fig. 2, 35 cm in diameter and 40 cm high. This drum is driven stepwise at noon and midnight by a cam-switch which is set on the polar axis. Six holes are allocated for each correction as shown in Fig. 3, in which screws are put properly according to the program. Microswitches are aligned behind the drum, which read the program to drive memory relays. According to this memory, correction

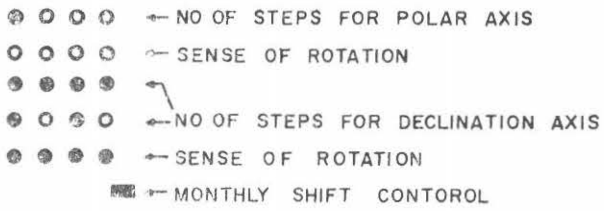

Fig. 3. Detail of a part of memory drum.

motors correct the axes in correct senses. One rotation of the memory drum corresponds to two months, and every two months, the microswitches for reading the memories are switched to those on the next raw. Six raws form a ring for endless operation.

Automatic calibration Calibration of the receiver gain is made every three hours by switching the input of the receiver to an argon-tube noise generator. As shown in Fig. 4, three levels are recorded during the calibration time, each one minute long. The first one corresponds to a level when the input of the low-frequency amplifier is short-circuited, the second one corresponds to the noise-tube level, and the last one corresponds to a level when the noise tube is turned off. The difference of the levels between the last two corresponds to 305 flux units.

Automatically operated attenuator 7-db attenuators are inserted successively on the i-f line each time when the record comes to off-scale. A timer starts at the first operation of the attenuators to reset them after ten minutes.

Operation during no A. C. power supply Though the observation is given up during no power supply, the clock and antenna is so designed as to continue their operation during ten hours. The auxiliary power system is shown in Fig. 5. The battery is recharged in 24 hours after the recovery of A. C. supply to recover the ten-hours' discharge.

Result of one-year operation The observation started in August 1970 and now more than one year has passed. Though the equipment was designed for carefree operation, there were a few troubles such as microswitch malfunctions, which were repaired by a non-specialized technician at the remote station. The most important trouble occurred in August 1971, when severe lightning hit the equipment, in which almost all the semiconductors in the preamplifier were destroyed including mixer diodes. An expert had to be dispatched to the remote station, which is placed at a 24 hours' trip distance by train, ship and car ! On the other hand, there were no damages due to severe typhoons. If the equipment were placed near the home station, the performance could be said quite satisfactory. But it is also true that we have realized how it is difficult to leave the equipment untouched throughout the year.

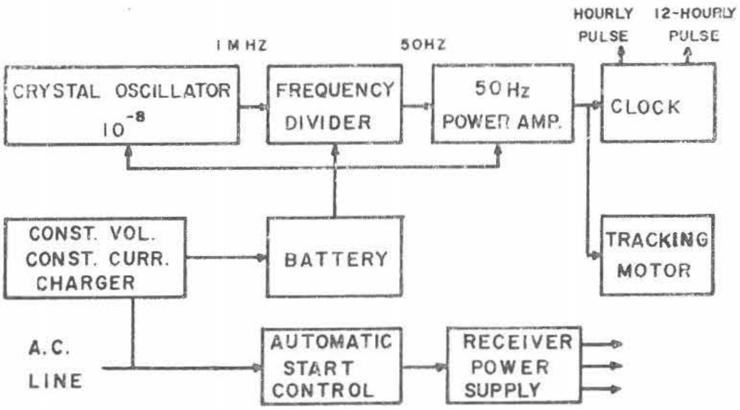

Fig. 5. Auxiliary power supply.

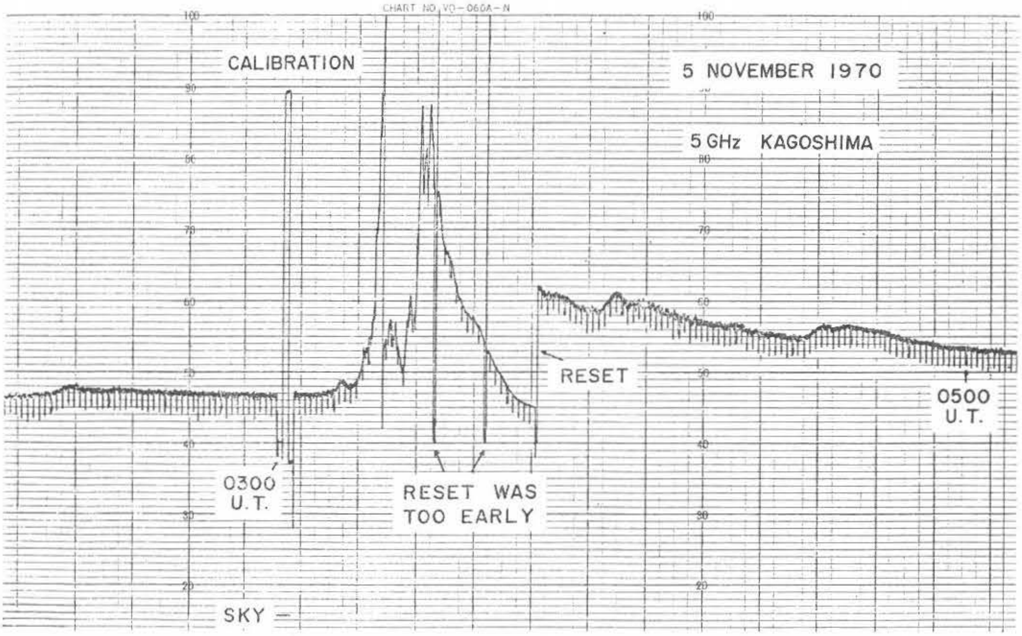

Fig. 4. An example of record.

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