HOUR ANGLE AND RIGHT ASCENSION READOUT

A.G. Little

This differs considerably from the declination unit. It is composed of two systems: (1) the antenna readouts and (2) the dummy antenna readout system. The antenna readout system is shown in Fig. 1. The synchro gearbox is similar in design to the declination unit but it has a shorter pinion shaft to allow it to fit inside the sprocket box and has a different gear ratio. If the grinding of the "body filler" is accurate to ± 10 thousanths of an inch, the readout will be good to ± 2 minutes of arc over the full 10 hours tracking.

The actual readout consists of an hour angle indicator and a right ascension indicator.

Hour Angle Indicators

Each hour angle is shown on a 5 digit counter which indicates 5 minutes of arc per revolution (0.5 per count or 2 seconds per count). It is intended that this counter should read 50,000 on the meridian. The unit wheel is subdivided by 0.1 minute of arc graduations. This counter follows the synchro output. The relation obeyed is

$$HA = \frac{\text{Reading} - 50{,}000}{1800} \text{ hours}$$

and the following table gives the nominal calibration.

Reading	Hour Angle
41,000	- 5 h.
42,800	- 4 h.
44,600	- 3 h.
46,400	- 2 h.
48,200	- 1 h.
50,000	0
51,800	1 h.
53,600	2 h.
55,400	3 h.
57,200	4 h.
59,000	5 h.

Another hour angle indicator in the form of a four-digit counter is located at each antenna and obeys the relation

$$HA = \frac{\text{Reading} - 5000}{300} \text{ hours}$$

Its rate is 11.25 per revolution (1.125 or 4.5 seconds per count).

Right Ascension Indicators

Each right ascension indicator, which reads in minutes (3 digits) and seconds (2 digits) of time, has two inputs. One from the sidereal motor (Figs. 1 & 4), a continuously rotating motor running from sidereal 50 cycles (derived from the clock) and another from the hour angle synchro receiver. The difference between these two is derived from a differential D (Fig. 4) so that if the antenna is tracking the sky the RA counter will be stationary. In all other situations the RA counter will be changing. Only the seconds drums of the counter (two right hand digits) will normally be required. These show the seconds of Right Ascension and are to be compared with the seconds shown for the RA of the dummy antenna when the individual RA's are being trimmed by manual adjustment through add or subtract buttonson each antenna drive. The smallest digit on the RA counter is 1 second of time. Each day the sidereal motor adds 1440 minutes to the RA indicator so that the three minutes digits cannot easily be interpreted. Only the third, or least significant minutes digit is correct. The digit representing tens of minutes will be interpretable only if one keeps track of date and time.

The hours and minutes of RA are obtained from the Decitrak system which has a display suitable for this purpose.

Dummy Antenna

An hour angle and an RA counter identical to the antenna readout units are provided which define the RA and HA of a dummy antenna. The dummy antenna is intended to agree in HA with an average value for the five actual antennas. The antenna motion is simulated by two motors - a dummy slew motor and a dummy track motor. These motors will be started and stopped by the antenna control buttons and are arranged to give the sidereal rate for track motion and a slew motion which is calculated to be the same as that given by the nominal chain-way radius, slew motor speed and gear box ratio. Should the radius not be exact, or should the start-stop transients differ, the antennas will be ahead or behind the dummy antenna when tracking is commenced. The discrepancy could be reduced by altering the gear ratios in the dummy slew motor train. However, because the five antennas will not have the same ratios, this should

not be done until all five are complete since it may be necessary to calculate a ratio which will give the best fit to all 5.

The Decitrak readout is also actuated by the dummy system and should read the right ascension of the dummy antenna in hours, minutes and seconds. With the dummy antenna fixed on the meridian (dummy HA = 0), it will of course indicate sidereal time. The seconds should correspond to the seconds reading of the dummy RA counter although the stated accuracy of the Dectrak is only 2 seconds. We require the Decitrak because it has an inbuilt coincidence circuit which conveniently allows starting the (six) track motors at a right ascension selected by a preset RA thumbwheel.

The panel layout for the RA control and readout is shown in Fig. 3. The Decitrak readout and preset RA thumbwheel is located on a panel below the control panel.

Initial Adjustment (or after power failure)

Set the antennas to an indicated hour angle of zero (nominally on the meridian). Isolate the dummy RA indicator from the system by loosening and/or removing pinion (25T-64DP, Fig. 2) directly driving the RA indicator. Drive the dummy slew motor until the dummy HA is zero. Operate the sidereal motor until the predesignated starting sidereal time is indicated on all five RA indicators. Manually turn the dummy RA indicator to the same sidereal time. Replace and tighten the pinion on the dummy RA indicator. At the designated start time turn on the sidereal motor. After checking the RA as indicated against the sidereal clock, corrections can be made by operating the momentary stop (-) or momentary 60 ~ (+) buttons which control the power to the sidereal motor.

Several modes of operation are possible.

(1) Remove from Stow Position

The Hour Angle drive cannot be operated until the front panel selector switch is in position B, C, or D (Fig. 3), and the Declination drive is outside the stow lock. If these conditions are satisfied the hour angle can be moved in any direction.

(2) Drive to Preset RA and Track

Assuming the antenna is free from the stow lock, set in preset RA, select B (Fig. 3) auto track position then press appropriate slew button to drive antenna to required RA. When this is reached the slew will stop automatically and after 1 second the antenna will commence tracking. Track will continue until stopped by stop button or a boundary is reached.

(3) Slew

Select position C on front panel and press appropriate slew button. Slew will continue until stopped by stop button or a boundary is reached.

(4) Track

Select position D and press track button. Track will continue as before.

(5) Auto Track

If the antenna is near the correct RA it may not be necessary to slew but just to wait until correct RA is reached. Thus if left on auto track and the thumbwheel is set correctly, antenna will start tracking one second after preset RA is reached.

Position Corrections

On the readout panel, two buttons are provided for each antenna to allow corrections to be made to the positions. The one marked plus allows the correct motor to operate which doubles the track speed. The one marked minus switches off the track motor and hence allows the antenna to slip behind. Both these operations are carried out whilst comparing the antenna RA with the dummy RA. The corrections only apply whilst the button is depressed.

Stow Procedure

1. Switch S4 (Dwg. RB-688) to Meridian Set position.
2. Actuate proper direction slew button.
3. When Meridian Indicator comes on:
   a. Set Switch on Declination Control Panel to STOW
   b. Drive each antenna north to stow by pushing P2 Slew North button for each antenna

Emergency Procedure

There is no procedure which is equivalent to the Declination Drive.

Entering Danger Zone

This is essentially thesame as for the declination drive. To drive the antenna beyond the boundary switches the key operated switch is closed. Then by holding down the spring loaded "dead man" switch, all antennas can be controlled as before. If the dead man switch is released, the antenna drive will stop and if any one antenna reaches a limit switch all will stop.

Remote Operation

The antennas can individually be controlled at the antenna station. The slew, track and correct motors can all be operated here but there is no provision for auto track. The meridian stow operation is available at the antenna but no "dead man" switch is available here so the danger zone entry switch cannot be used at the antenna station.

List of Drawings

Circuit diagrams

RB-685	Antenna Limit Switches
RB-686	RA Drive Control Antenna Station
RB-688	RA Drive Control - Control Room

Mechanical

Synchro Gear Box

RD-681	
RD-682	same as for Declination
RD-683	
RD-684	RA Readout Synchro Gearbox Mounting Location

Readout Panel

RD-664	RA Readout Assembly
RD-665	RA Readout Details
RC-666	RA Readout Details
RC-667	RA Readout Details
RC-668	Main Frame Details
RC-670	RA Readout Back Plate Details

RB-671 Side View RA Readout
RD-672 Right Ascension Readout-Decitrak Mount
RC-673 Right Ascension Readout-Decitrak Mount Details
RC-674 Schematic Diagram of Gear System for RA Readout

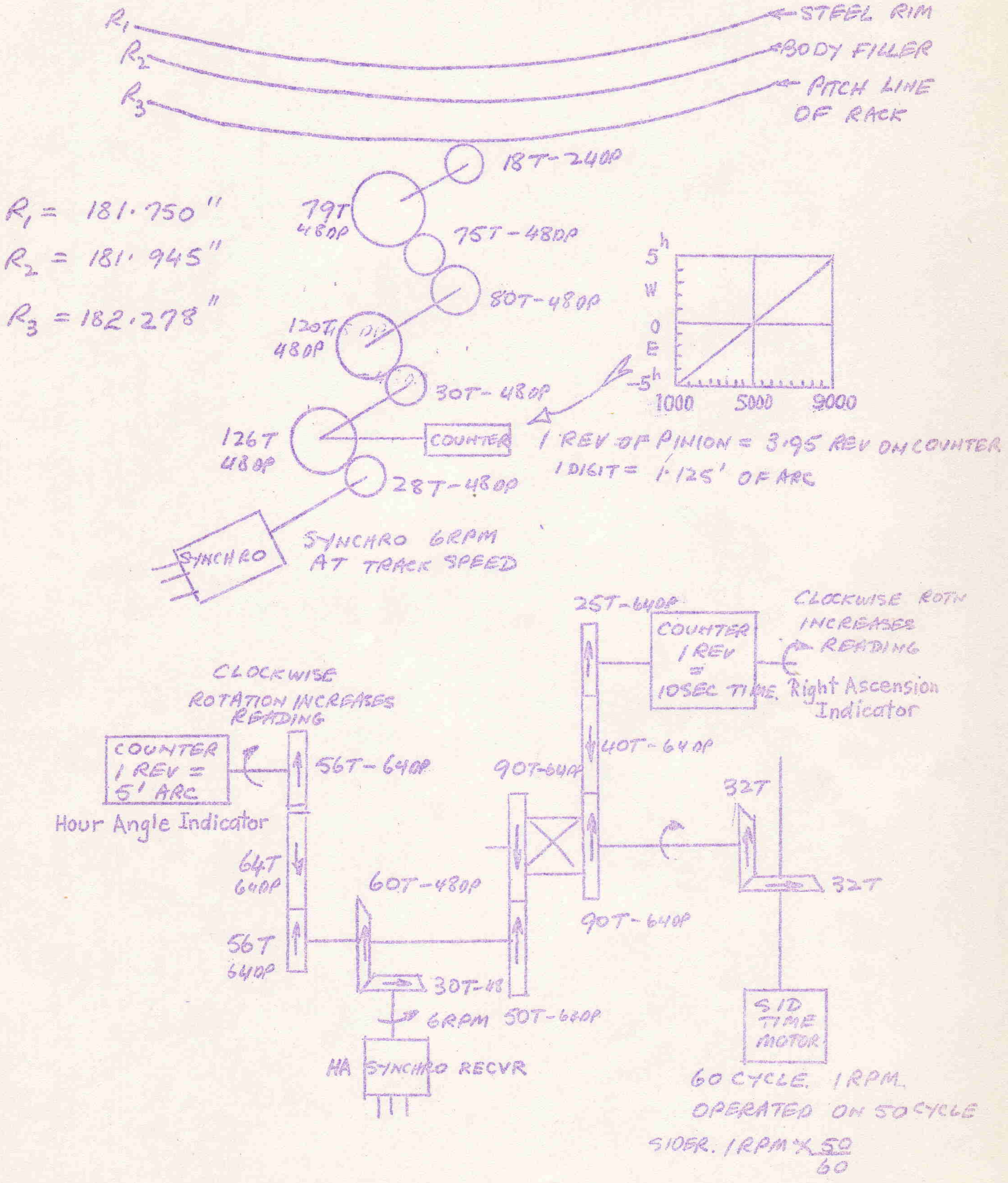
Jobs to be Done

1. The synchro gearbox has to be mounted on the RA sprocket box. At the moment the best location is not certain as the sprocket box is being moved around during adjustments.

2. It would be wise to provide a separate cover over the whole gearbox and synchro to protect them both.

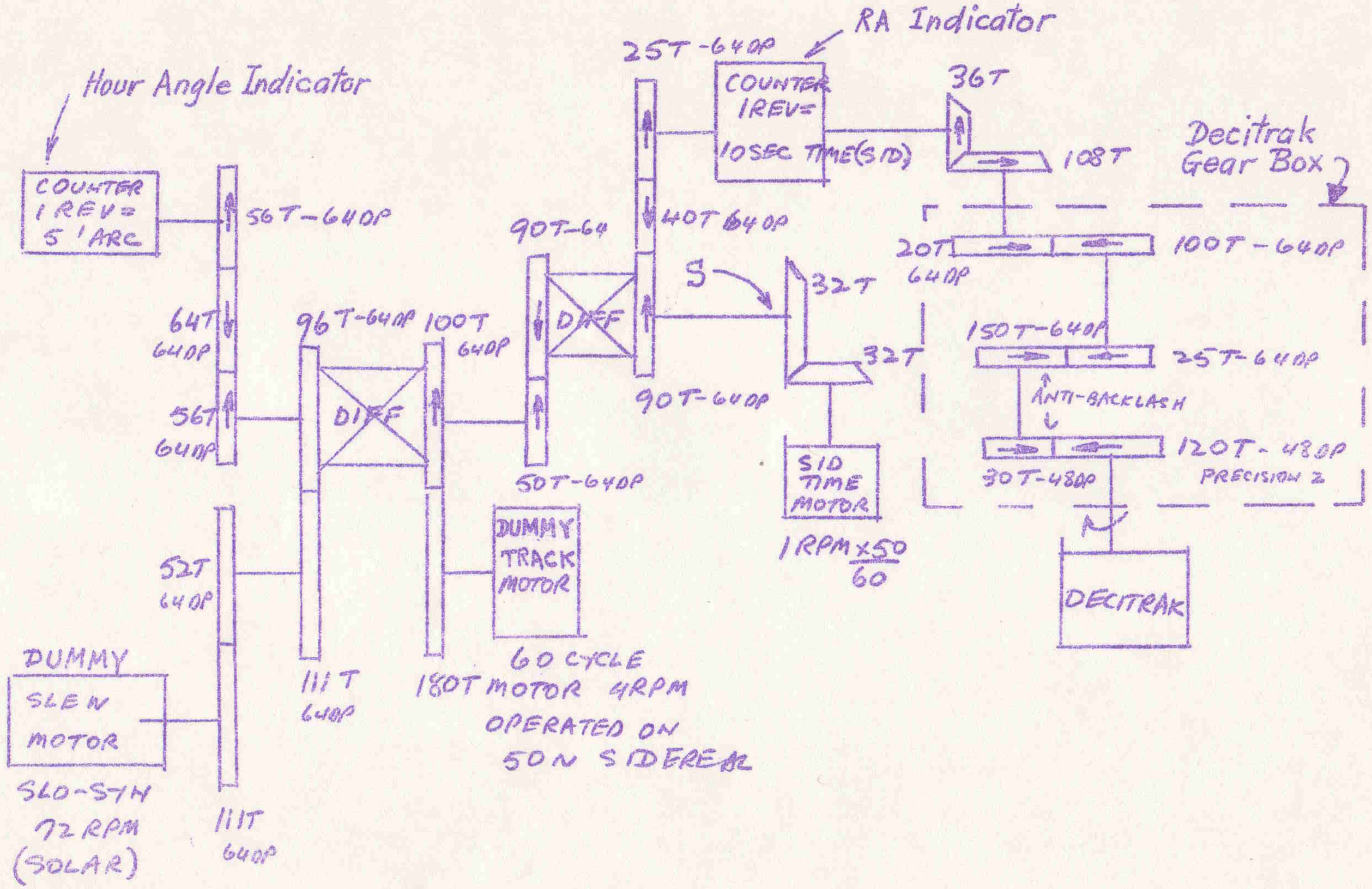
3. To complete the five units, more gears, synchros and counters will have to be ordered as well as some more brackets to be machined.

4. Six HA counters and 5 four-digit counters are to be ordered, sense of rotation opposite to that of the one of each already delivered.



ANTENNA HOUR ANGLE AND RIGHT ASCENSION READOUT SYSTEM

FIG 1



SCHEMATIC OF "REFERENCE" READOUT SYSTEM

FIG 2

STOWED (LAMPS)

(RED)

HOUR ANGLE (MECHANICAL)

50000

(COUNTER)

RIGHT ASCENSION

min SEC

180 59

(COUNTER)

TRIM R.A.

+ −

50000 180 59 + −

50000 180 59 + −

50000 180 59 + −

50000 180 59 + −

DUMMY HA

50 000

DUMMY RA

180 59

BOUNDARY LIMIT

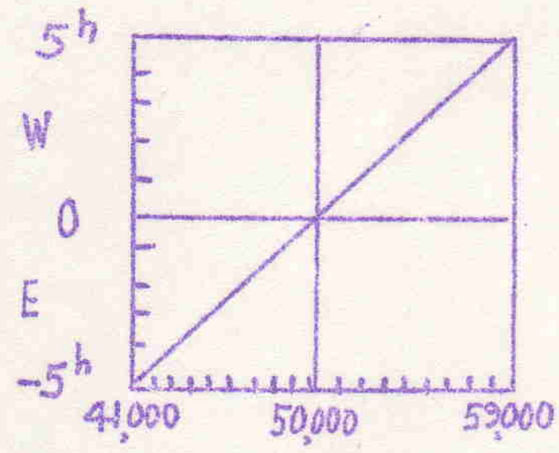
E

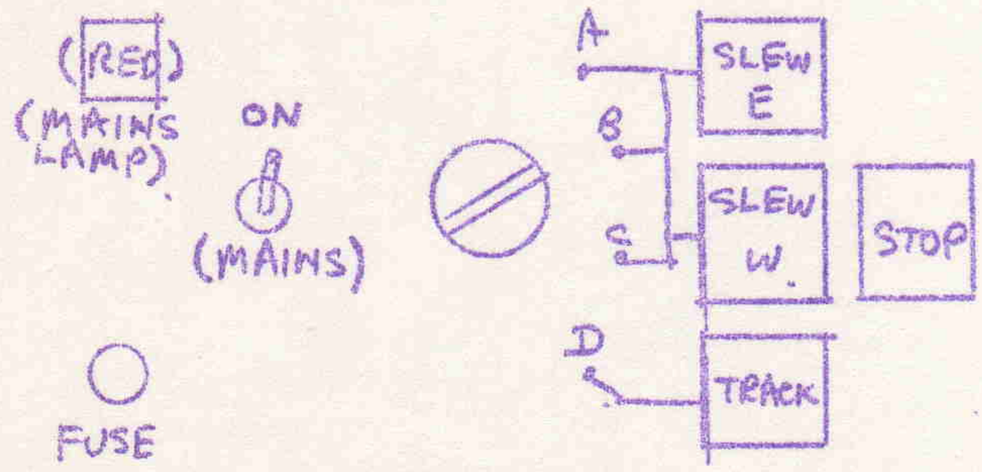
SE

SW

W

(AMBER) (RED)





A = ~~SLEW~~ STOW C = SLEW

B = AUTO TRACK D = TRACK.

RIGHT ASCENSION READOUT AND CONTROL PANELS

FIG. 3.

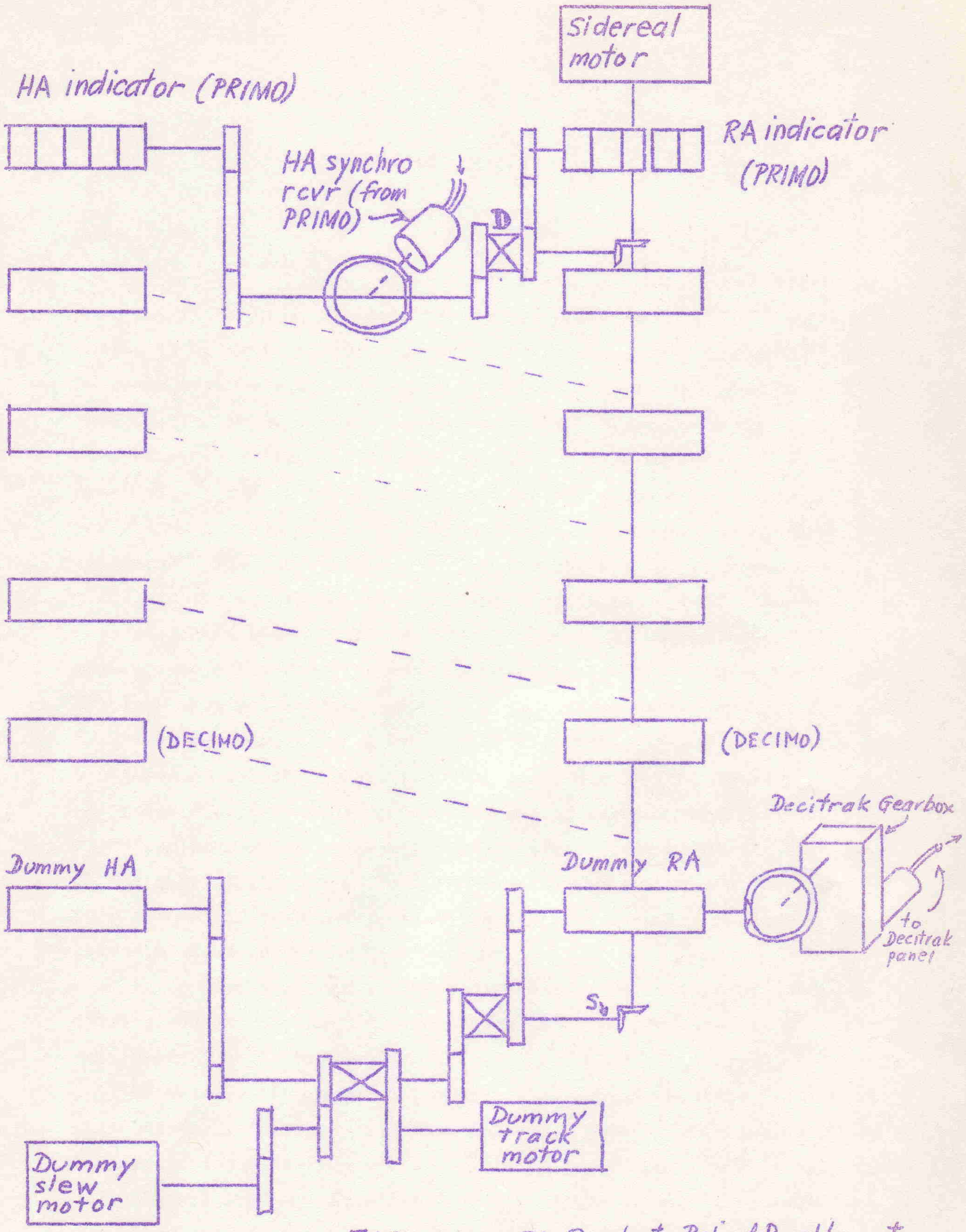


FIG. 4 — RA Readout: Behind-Panel Layout