WODC 02-28

WIYN OBSERVATORY
Wisconsin-Indiana-Yale-NOAO

MEMORANDUM

TO: Matt Johns, Dan Blanco
FROM: Dave Sawyer
DATE: 10-19-93
SUBJECT: Encoder Alignment

The installation and alignment of the elevation and azimuth encoders has been completed. The load cell measurements and the steering adjustments seemed to work very well. Overall, the alignment process is pretty straight forward now that I understand it.

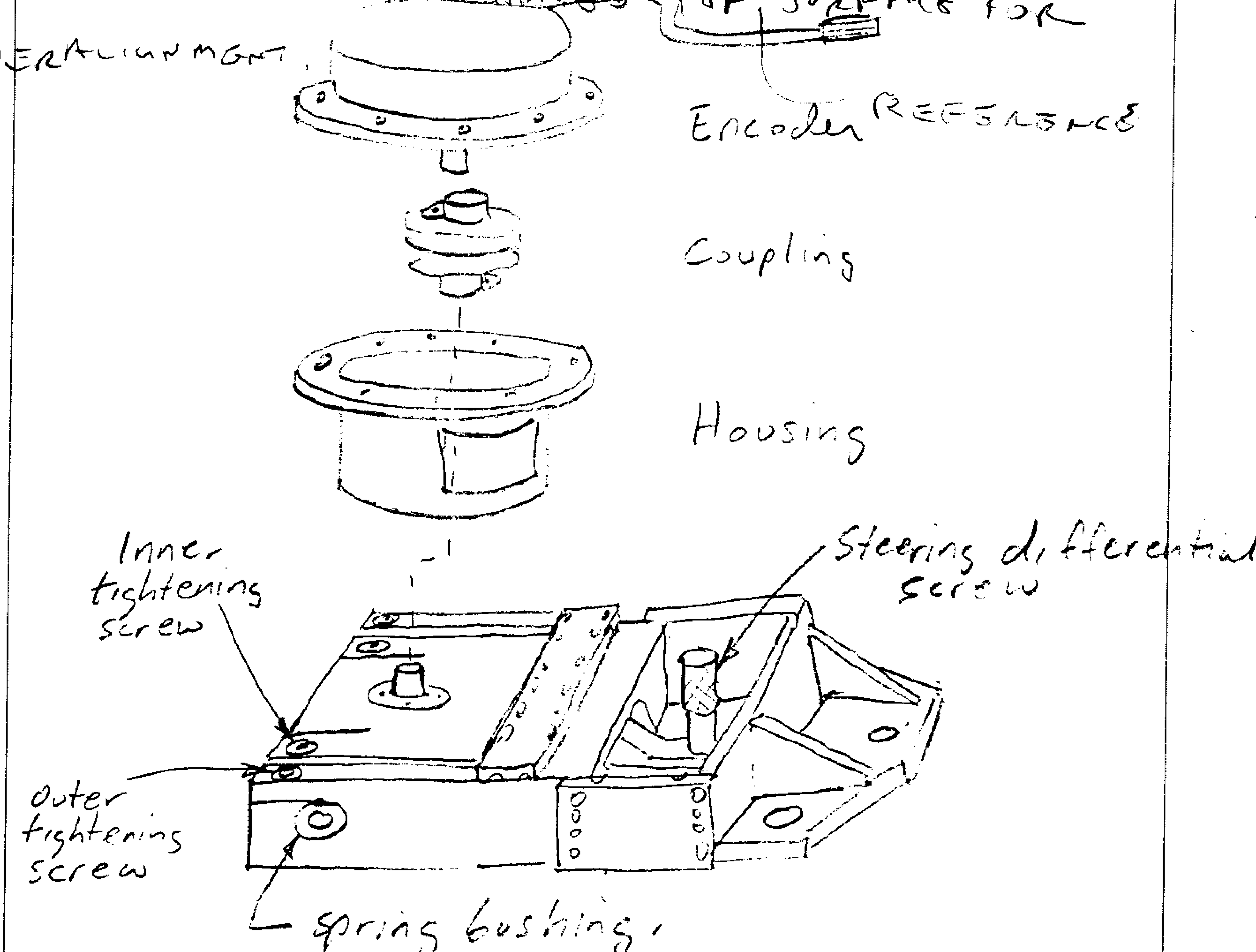
Attached is a copy of my notes detailing the installation and alignment process. Please review them and give me your comments. Pay particular attention to the terminology that I used. In some cases I made descriptive names up. I would like my notes to be accurate as I will probably reference them for documentation later on.

Encoders Elevation and Azimuth

1. TORSION Spring Bushings - provide PRELOAD spring tension for adjustment ~~of~~ the steering angle of the STEERING capstan on the disk.

REMOVE THE ~~* the inner clamps for the bushing were loose. The only way to access the screws to tighten is~~ to remove the Heidenhain encoder, coupling, and housing. THIS ALLOWS ACCESS TO THE ~~MACHINES~~ TOP SURFACE FOR ENCODER ALIGNMENT

→ TO THE TIGHTENING SCREWS FOR THE TORSION SPRING ADJUSTMENT

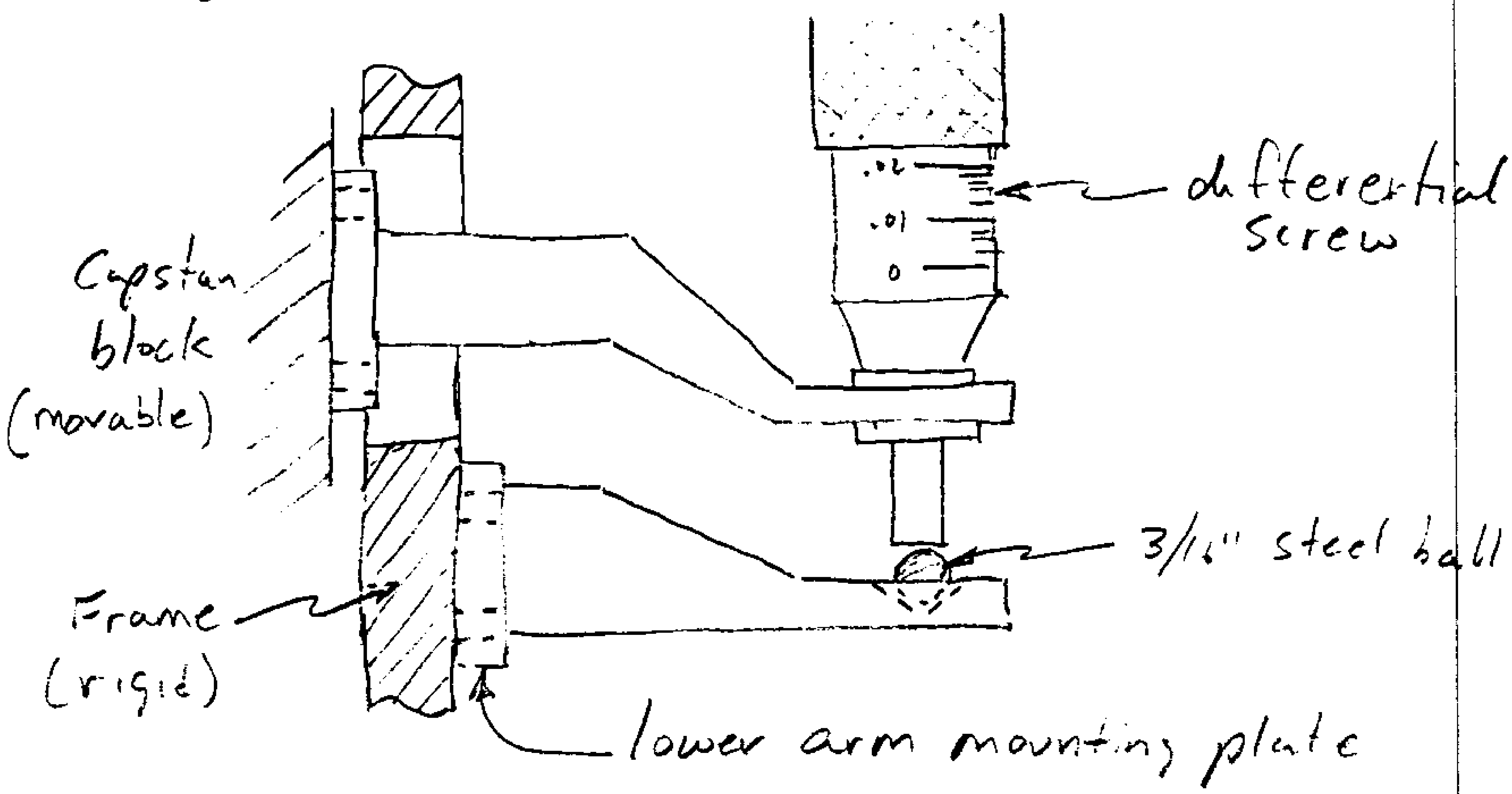


Encoders (cont'd)

SET. PRELOAD IN THE CAPSTAN STEERING ADJUSTMENT MECHANISM.

TORSION SPRING SET-UP

2. Steering ~~Adjustment assy.~~ - ~~provide~~ leverage necessary to apply tension to the spring bushing using the differential screw.



* For proper alignment of the differential screw and the 3/16" steel ball, it was necessary to remove 0.060" of material from the face of the lower arm mounting plate.

- Setting the spring bushing tension:
  With the inner bushing clamps loose, the diff. screw was set to 0.035" and then held against the steel ball while the bushing clamps were tightened. This gives a good spring tension with the diff. screw centered at 0.025".

Encoders (cont'd)

3. Elevation Encoder Installation.

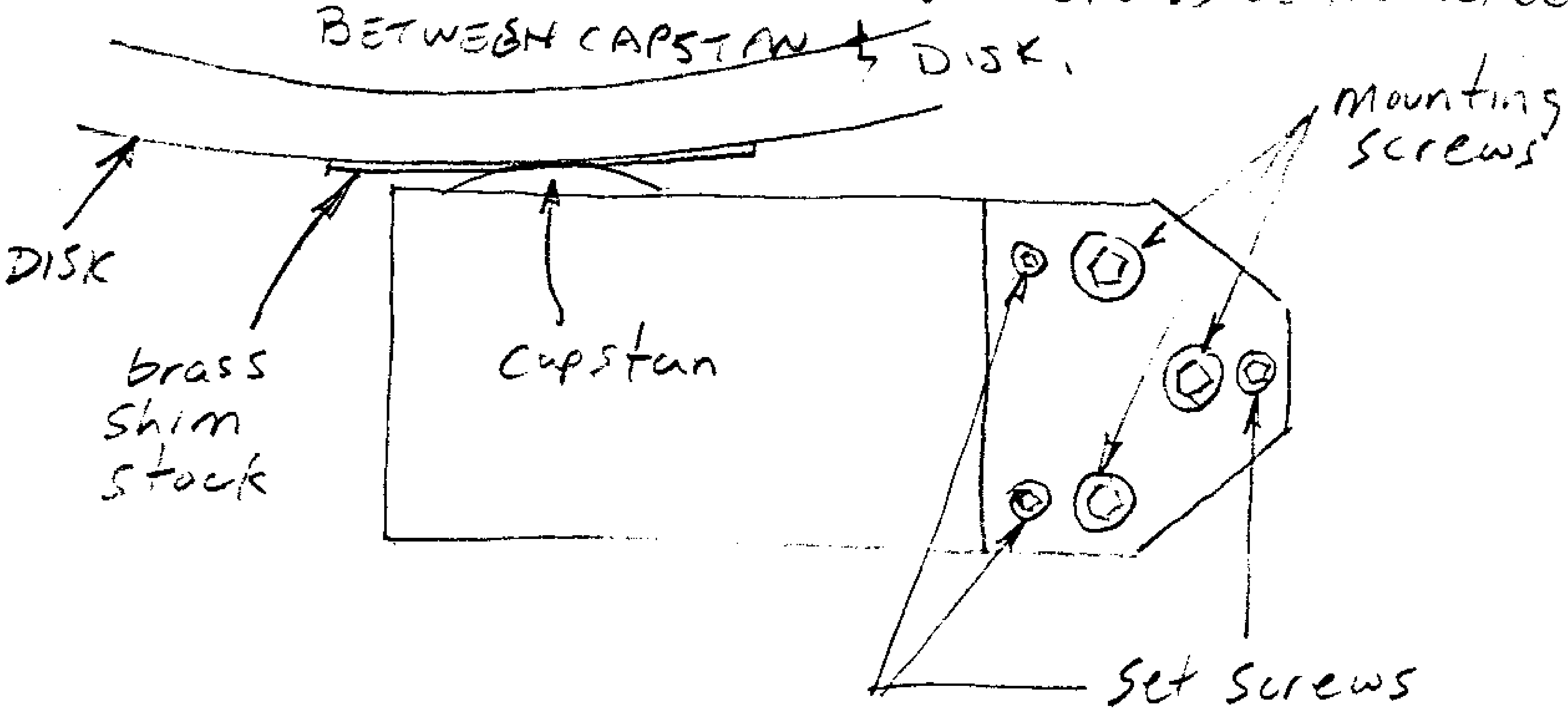
a.) Back out the set screws on the mounting plate so that the mounting plate sits flat on the mounting footprint on the fork.

→ BACK OFF THE PRELOAD SPRING.

b.) Set the encoder in place and install the 1/2-13 mounting screws. Tape a piece of 5 mil brass shim stock on the disk so that the encoder capstan will seat against the brass shim. Gently rotate the encoder so that the capstan seats against the brass shim and tighten the mounting bolts

REMOVE SHOULDER

CAUTION: AT THIS STAGE THERE SHOULD BE NO FORCE BETWEEN CAPSTAN & DISK.



c.) With the mounting bolts tight, screw in the set screws so that they ~~just~~ seat.

4. Azimuth Encoder Installation

a.) The azimuth encoders mount to a bracket ~~which~~ that must be properly positioned before installation of the encoders. There are three motions to consider.

1. The base of the bracket where the encoder mounts must be square to the face of the disk.

2. The horizontal adjustment should allow encoder positioning so that only the capstan touches the disk

CAUTION: MISALIGNMENT OF THIS ADJUSTMENT WILL ALLOW THE CASE TO CONTACT & DAMAGE THE DISK.

3. The vertical adjustment (which was an added modification during installation) allows the encoder to be positioned so that the capstan tracks in the center of the disk.

NOTE: THE VERTICAL & HORIZONTAL ADJUSTMENT USE THE SAME MECHANISM: OVERSIZE BRACKET MOUNTING HOLES.

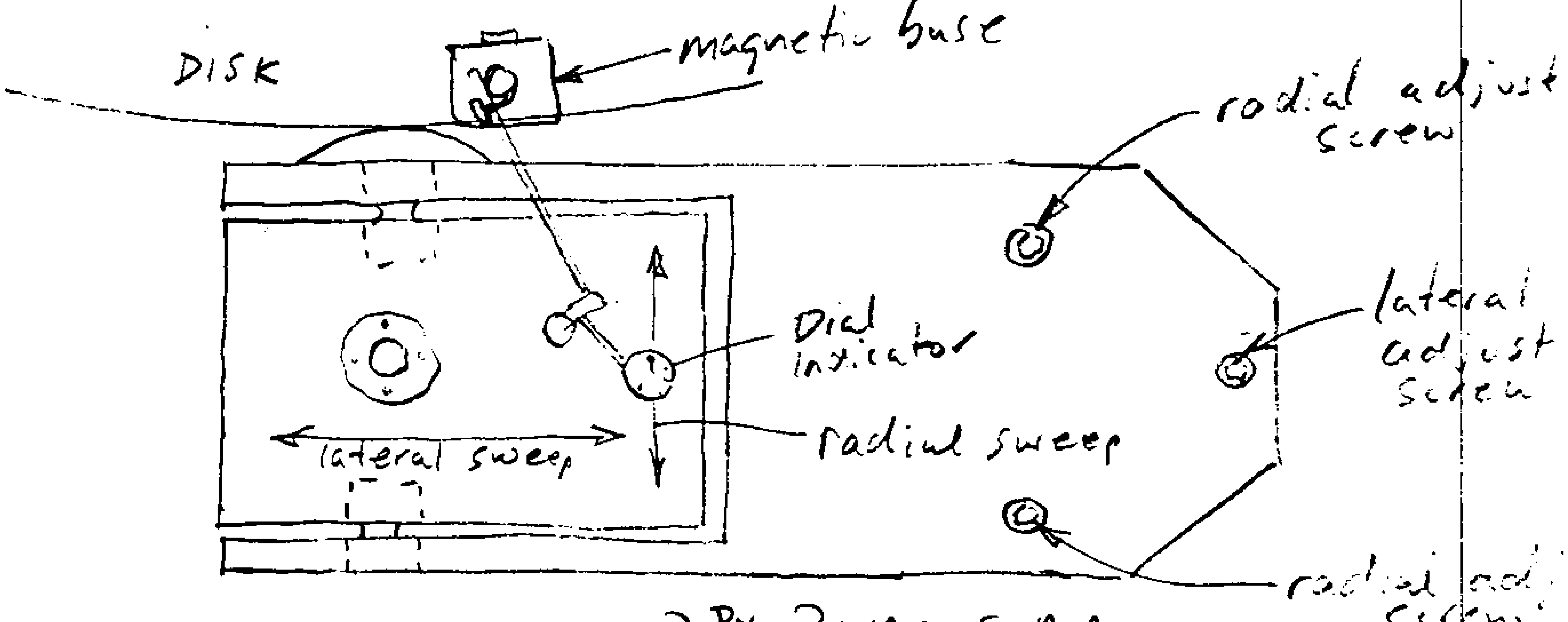
b.) Once the bracket is securely fastened, the installation procedure is identical to the elevation encoder described in step 3.

rest of

... FASTENED TO THE AZIMUTH SUPPORT FRAME IT SHOULD **NEVER** BE REMOVED.

5. Encoder Alignment (Elevation & Azimuth)

a.) Set up an indicator on a magnetic base and clamp to the disk so that the plane of the capstan block can be checked against the plane of the disk.



- First sweep the dial indicator [→ BY ROTATING MAGNETIC BASE] in a radial direction towards and away from the disk. Adjust the [→ RADIAL ADJUST] set screws to ~~align the planes~~ ELIMINATE INDICATOR RUN-OUT.

  Note: the set screws give .050" of adjustment per full turn. ~~at the spacing of the screws~~ TURN THEM EQUAL & OPPOSITE AMOUNTS TO MINIMIZE DISTURBING THE LATERAL ADJUSTMENT.

- Next sweep the dial indicator in a lateral direction parallel to the disk. Adjust the set [→ lateral] screw as needed.

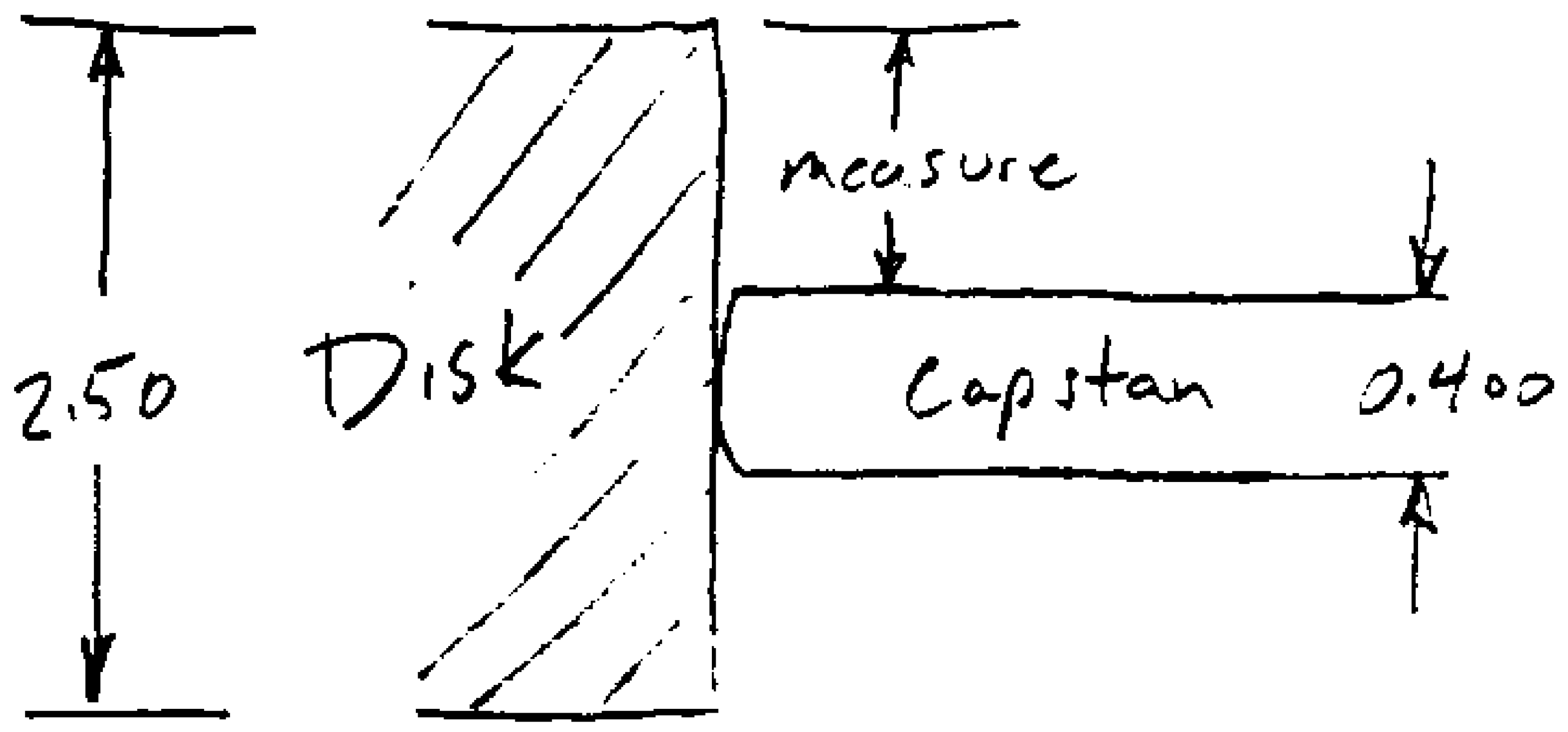
THIS CAN BE DONE BY ROTATING THE TELESCOPE

- Recheck both radial and lateral alignment.

→ CHECK CAPSTAN CENTERING ON DISK & READJUST IF OUT OF TOLERANCE.

5. Encoder alignment (cont'd) DO THIS BEFORE STEP (a) ?

b.) Use a vernier caliper or a depth micrometer to measure the position of the capstan WRT the disk.



Cross section of disk and capstan.

- For the capstan to track on the center of the disk the measured position should be

$$\frac{1}{2}(2.50") - \frac{1}{2}(0.40") = \boxed{1.05"}$$

TOLERANCE = ?

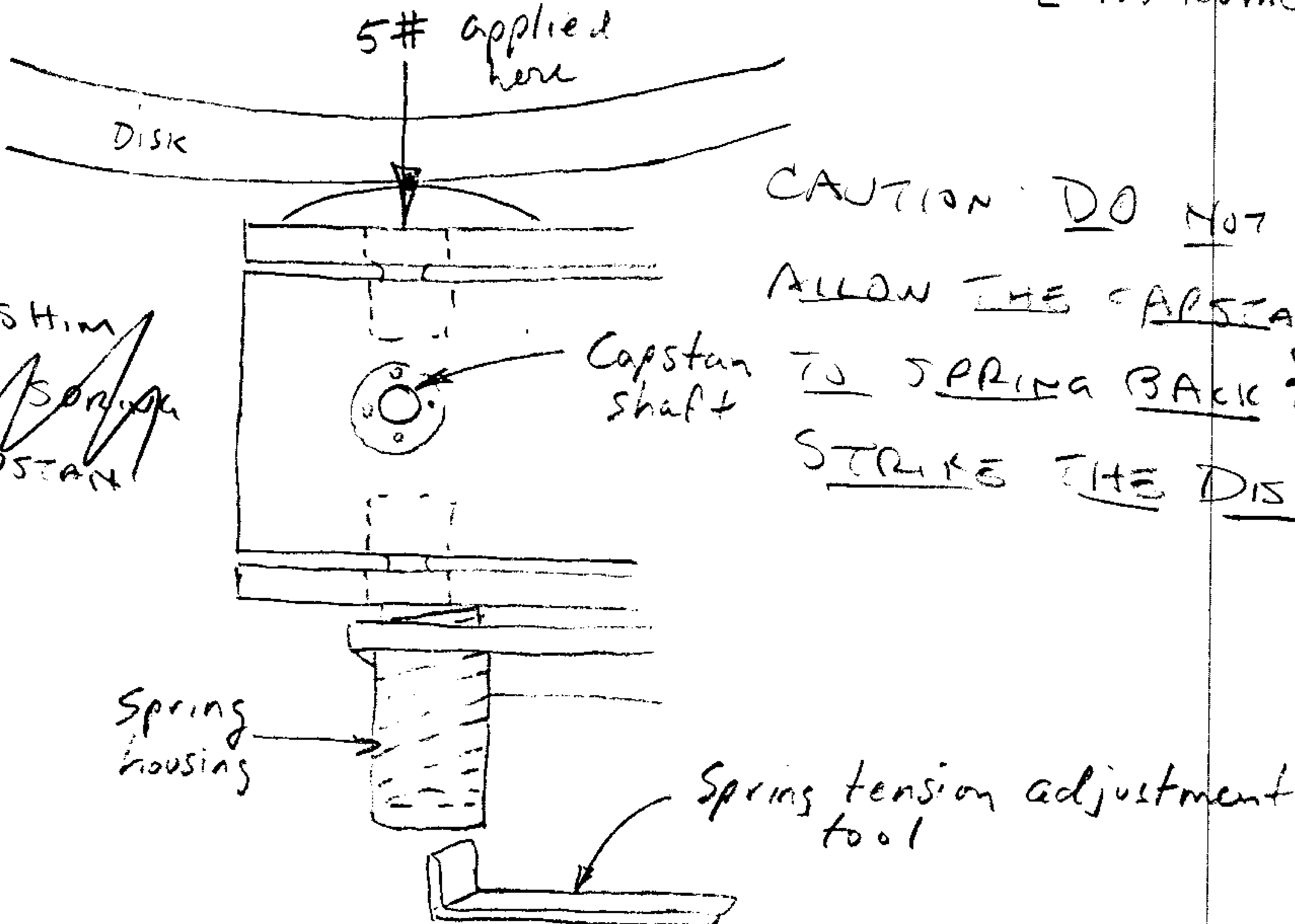
- Given that the set screws give 0.050" per full turn, figure how many turns are needed to center the capstan and adjust all three set screws equally.

c.) Repeat steps (a) and (b) until alignment is achieved.

Note: Make sure that the capstan is touching the brass shim when the mounting screws are tightened the final time.

6. Setting the Load Force on the Capstan

a.) Remove the brass shim and apply a 5# force against the capstan bushing in a direction radially away from the disk WITH [INSTRUMENT].



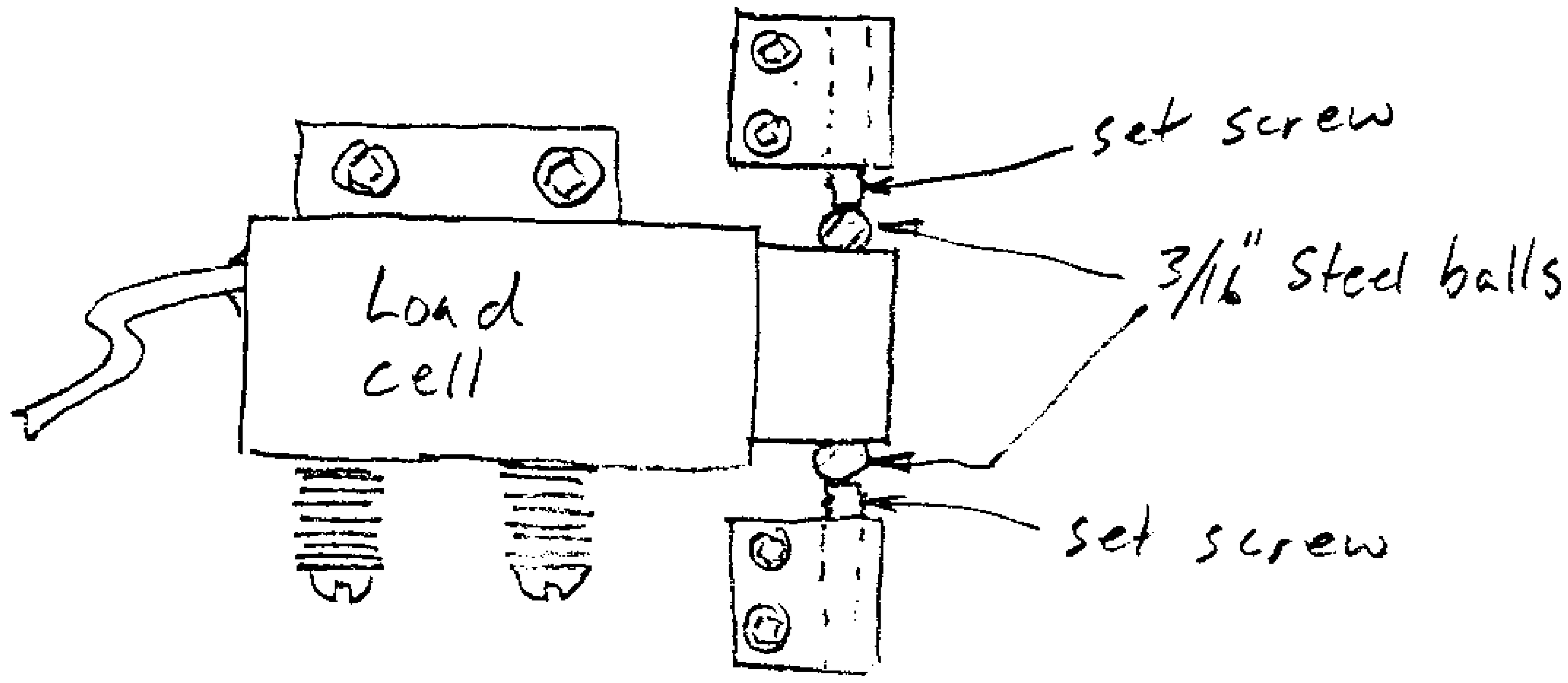
~~- REMOVE SHIM~~
~~- TIGHTEN SPRING UNTIL CAPSTAN JUST~~

CAUTION: DO NOT ALLOW THE CAPSTAN TO SPRING BACK & STRIKE THE DISK.

b) With 5# of force applied, screw in the slotted plate on the end of the spring housing using the adjusting tool until the capstan just touches the disk. This can be felt by turning the capstan shaft as the spring tension is adjusted.

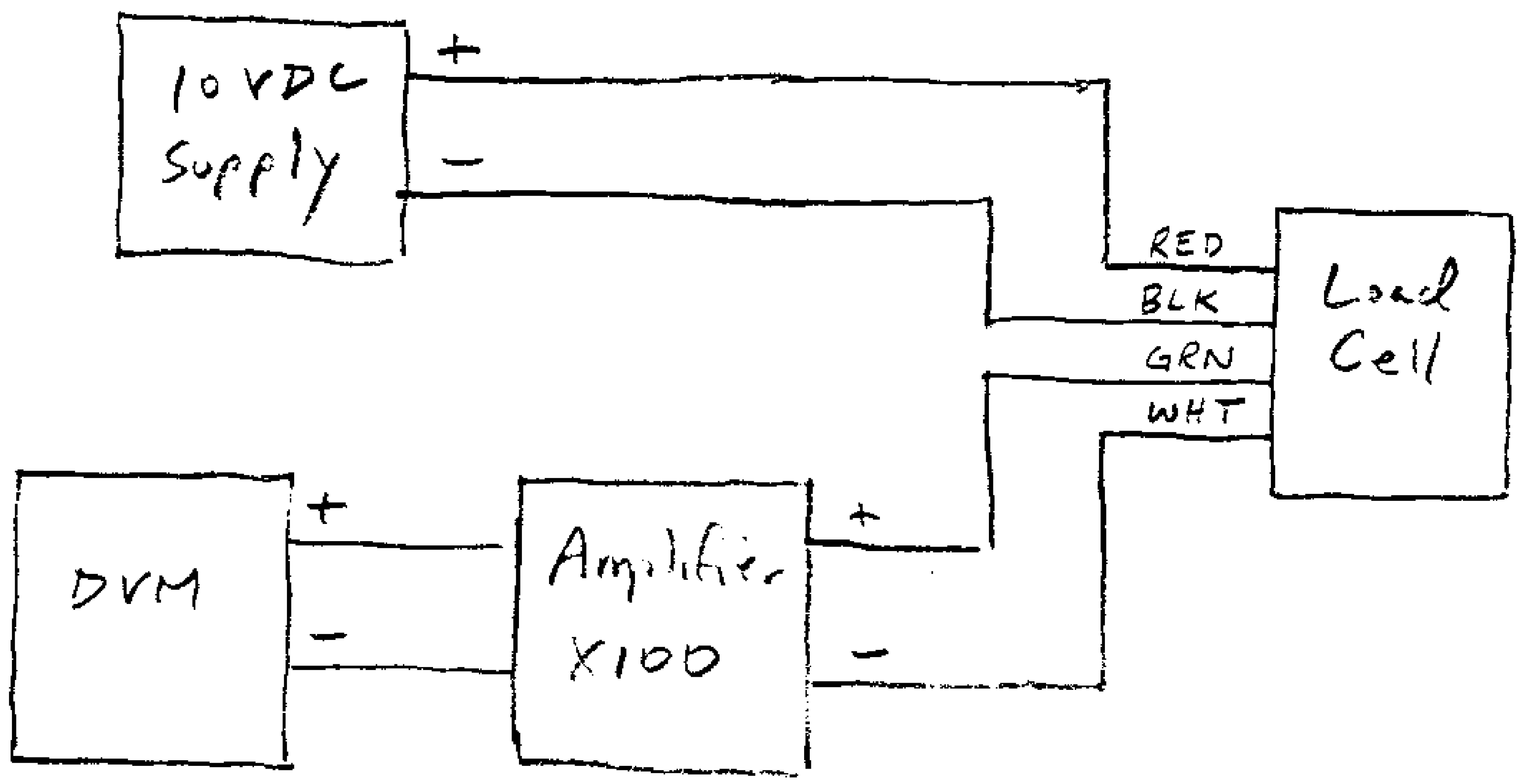
7. Load Cell Measurements

a.) Install the load cell with 3/16" steel balls as shown.



adjust the set screws to hold the steel balls snugly against the load cell

b.) Connect the load cell test circuit per the following schematic.



7.) Load cell measurements (cont'd)

c.) With 10VDC applied to the load cell, a stable DC voltage output should be measured. Adjust the set screws on the load cell to obtain an output near zero volts.

d.) Slew the telescope in one direction and then the other and note the voltage output changes with direction.

Note: It is best to pick a reference point for measurement. Slew beyond that point each time and record the output as the reference point is passed. This minimizes effects from external sources.

e.) Adjust the differential screw to null out the direction dependent variations.

Note: The bushing clamps may have to be re-seated to allow the full range of adjustment on the differential screw. Make sure the load force on the capstan (step 6) is released before re-seating the clamps and then re-applied after.

Encoder load cell testing

NE Azimuth:

+ E → S (clockwise looking down)
− E → N

screw setting	Amplifier Output (FWD) + direction	(REV) − direction	diff.
.025	+.418	+.394	+.024
	.410	.380	+.030
30 min later (amp. drift?)	.280	.251	+.029
.030	.170	.140	+.030
	.167	.145	+.022
	.171	.149	+.022
.035	.121	.090	+.031
	.116	.090	+.026
	.117	.090	+.027

Set screw @ .045 and reset inner bushing. With screw @ .040 capstan block is high by 0.004 on end away from mtg. screws over length of block. (~4.5")

.040	(+.004)	−.520	−.555	+.035
		−.510	−.558	+.048
Dan finish electrical (2 hrs)		−.510	−.558	+.048
.030	(−.001)	−.275	−.316	+.041
		−.286	−.321	+.036
		−.289	−.326	+.037

NE Azimuth (cont'd)

Reset inner bushing with screw set at .025
With screw @ 0.020 the capstan block is low by 0.010 over length of block (4.5")

Setting	tilt	(FWD)	(REV)	diff.
.020	-.010	-.540	-.540	0
		-.549	-.542	-.007
		-.545	-.540	-.005
.015	-.013	-.400	-.379	-.021
		-.419	-.388	-.031
		-.420	-.390	-.030

Appears that setting is between .020 and .025 on screw. Reset inner bushing with screw set at .030.

Setting	tilt	(FWD)	(REV)	diff.
.025	-.006	-.504	-.537	+.033
		-.511	-.541	+.030
.0225	-.007	-.456	-.481	+.025
		-.456	-.482	+.026
.020	-.009	-.400	-.403	+.003
		-.396	-.402	+.006
.019	-.010	-.410	-.388	-.022
		-.384	-.373	-.011
Setting = .01975		-.394	-.396	+.002
		-.396	-.397	+.001

SW Azimuth Encoder

Initial bushing setting: differential screw set @ 0.035" which puts the capstan block low by 0.001" over the length of the block (4.5") on the end away from mounting screws.

Setting	tilt	(FWD)	(REV)	diff
0.030	-.001	-.169	-.227	+.058
		-.165	-.222	+.057
10-19-93		-.206	-.255	+.049
0.025	-.002	-.298	-.347	+.049
		-.295	-.343	+.048

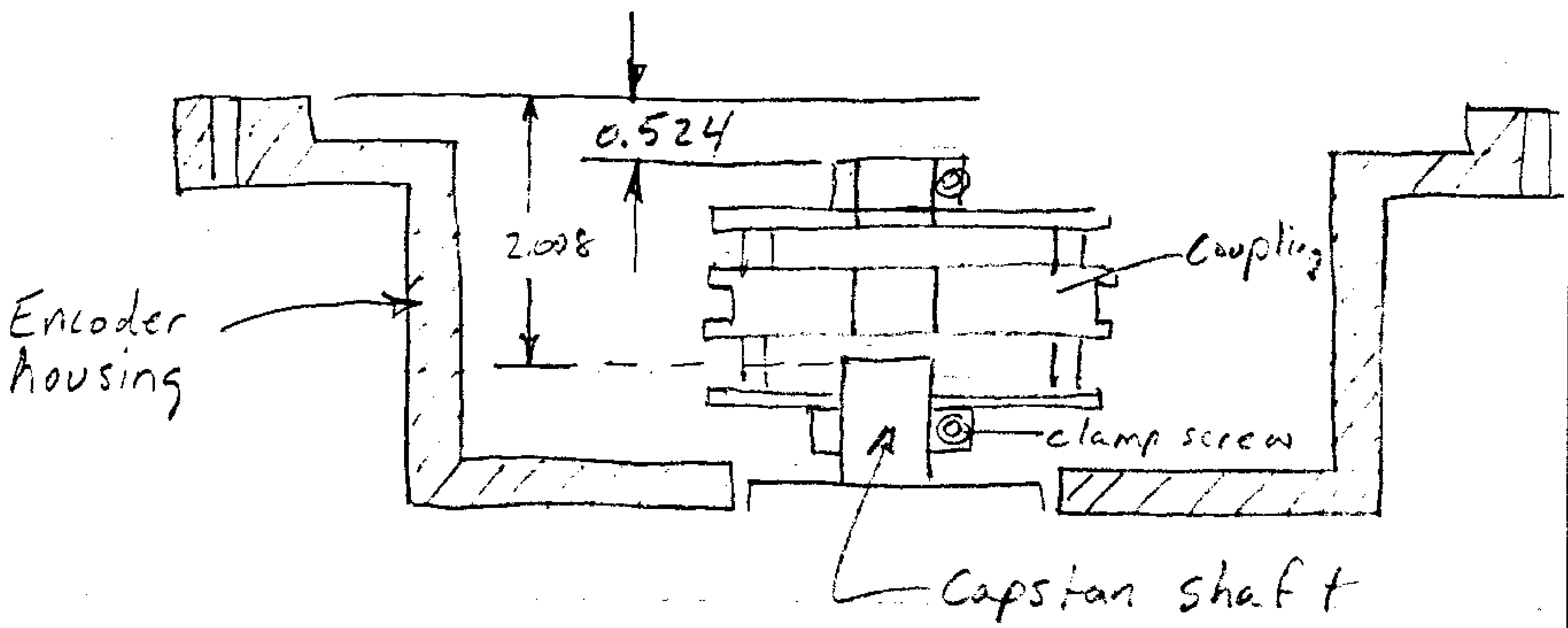
Reset inner bushing with diff. screw set @ 0.025

Setting	tilt	(FWD)	(REV)	diff
0.020	-.006	-.327	-.371	+.044
		-.333	-.372	+.039
0.015	-.009	-.408	-.438	+.030
		-.403	-.434	+.031
0.010	-.012	-.480	-.477	-.003
		-.478	-.475	-.003
0.01025		-.479	-.480	+.001
Setting		-.482	-.482	∅
		-.480	-.480	∅

9. Final Assembly of Encoder

a.) assembly the encoder housing onto the encoder block.

b.) Install the coupling onto the capstan shaft so that it is 0.524" below the top edge of the encoder housing. tighten the lower clamp screw.



space between shafts 2.008 - 1.015 = 0.993
length of coupling = 1.975
amount of shaft overlap = $\frac{1}{2}$(1.975 - 0.993) = 0.491

c.) Carefully install the Heidenhain encoder and tighten the top clamp screw on the coupling.

d.) Replace the access plate cover on the side of the encoder housing.

Note: The elevation encoder will require the capstan load force to be reset due to the added weight. (see step 6)