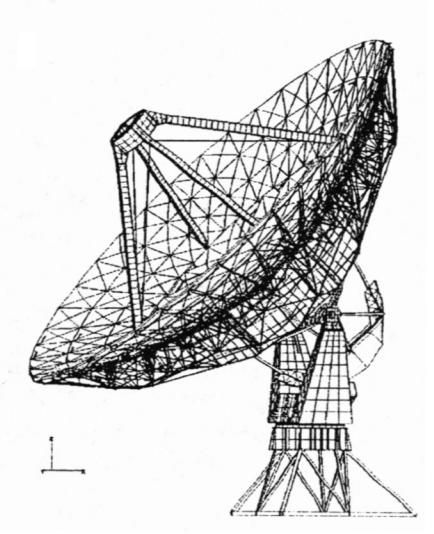
NATIONAL RADIO ASTRONOMY OBSERVATORY
Socorro, New Mexico

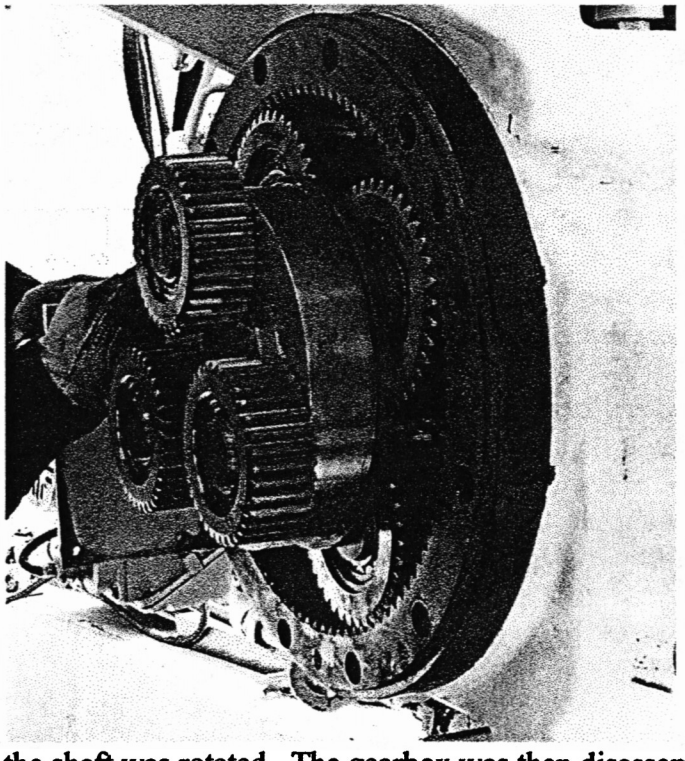


VLBA Antenna Memo Series No.37

# Owens Valley Gearbox Repair

J. E. Thunborg
April 26, 2002

On April 4, 2002, The Owens Valley VLBA Antenna was removed from service because of frequent "azimuth current motor sums greater than 30 amps" errors. The motor current plots recorded during observations showed periodic current fluctuations of 5 - 10 amps amplitude and 2 hour period. After a complete check of the drive electronics, the site techs (Jim Brown and Bill Robins) used a ½ inch drill motor to power the antenna in Azimuth. They found that the antenna had tight spots where the drill motor did not have sufficient power to turn the antenna.



On April 5, 2002, Phillip Sanchez and John Wall left for Owens Valley in the Volvo truck. The truck was loaded with all the tools and parts required to repair any element of the azimuth drive system. Phillip and John arrived at the Owens Valley site on April 7 where they were met by Steve Tenorio and Jon Thunborg. After an initial inspection of the azimuth rail and drive wheel bearings, the antenna was jacked up so that azimuth drive #1 could be rotated by hand. Turning the input shaft of the gearbox by hand revealed several tight spots as the shaft was rotated. The gearbox was then disassembled so that the internal components could be inspected.

The sun gears in all 4 stages showed wear on the counter clockwise rotation side. The thrust bearings in the first and second stages were also quite worn. Because of this wear the spare gearbox was disassembled and the following new parts were placed in the azimuth #1 gearbox;

Sun gears, Stages 1 – 4
Thrust bearings, Stages 1 – 2
Planetary gears, Stages 1 – 3
Ring gear (Intarnal gear), Stage 4
Roller bearings, Stages 1 – 3
Carriers, spacers and retaining rings, Stages 1 - 3
*Stage 1 is the input stage.*

When the gearbox was reassembled, the new gear assembly was found to be about 0.020" too long. This caused the gearbox to seize up when the housing was bolted together. In order to remedy this situation, a 0.032" felt gasket was placed between the housing halves. The gearbox was then tested and operated smoothly.

Azimuth gearbox #2 was then disassembled and inspected. It had similar wear as gearbox #1 except its wear was on the clockwise rotation side of the gears. Only the second stage sun gear and thrust bearings were replaced on this gearbox as no other parts were available.

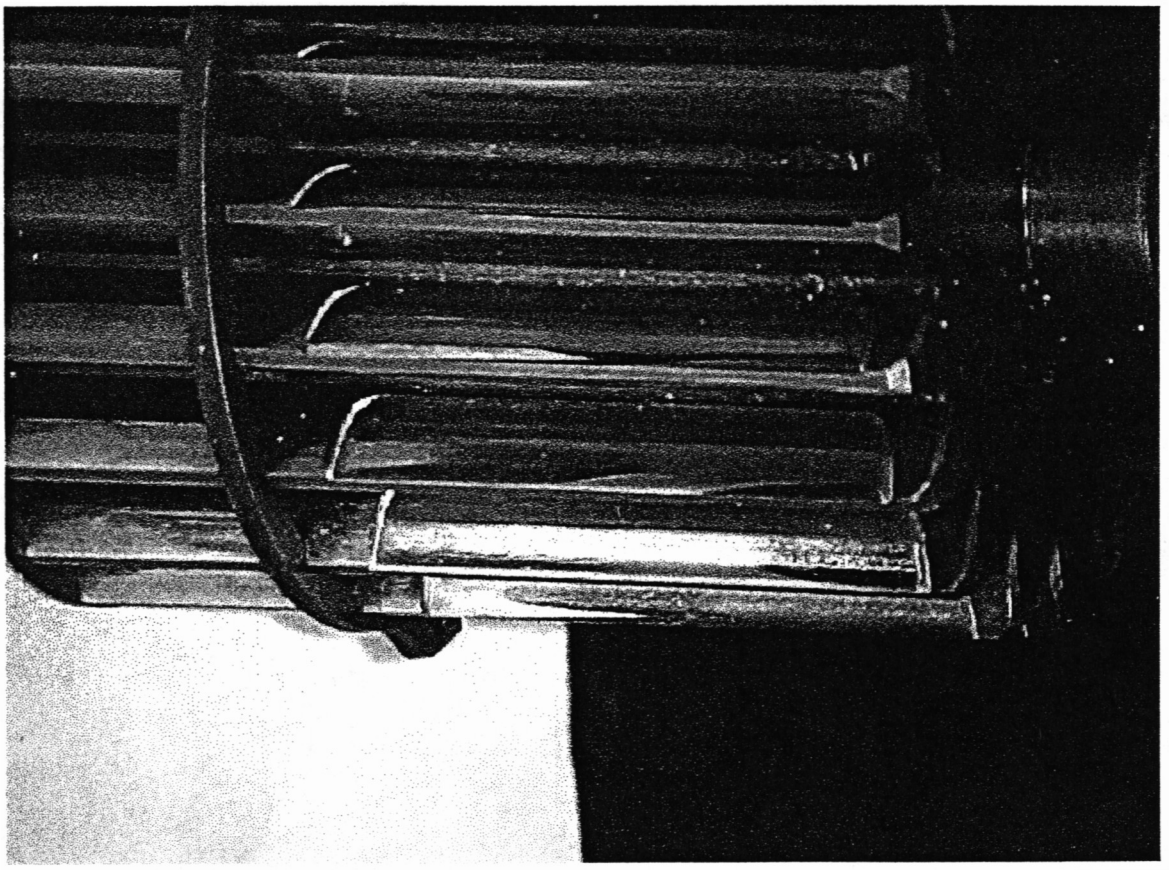
The antenna was put back into service the evening of April 9th. After several days of service, the motor currents looked typical. The periodic current fluctuation had disappeared, however the "azimuth current motor sums greater than 30 amps" errors are still more frequent than at other sites. After researching the meaning of the sum of the motor currents error, I discovered that originally this error was not generated in azimuth until the sum of the motor currents reached 60 amps. After the axle broke in Brewster, this error threshold was brought down to 30 amps, which is very close to normal operating parameters.

Replacement gearbox parts are being ordered to replace the ones used from the spare gearbox. We will also order an additional set of sun gears and bearings so we will have the capability to replace the high wear parts on 2 gearboxes. It is imperative that we keep these parts on hand because the delivery time from Sumitomo can be upwards of 6 months. The Azimuth gearbox model number is SPHJ-135S-848.

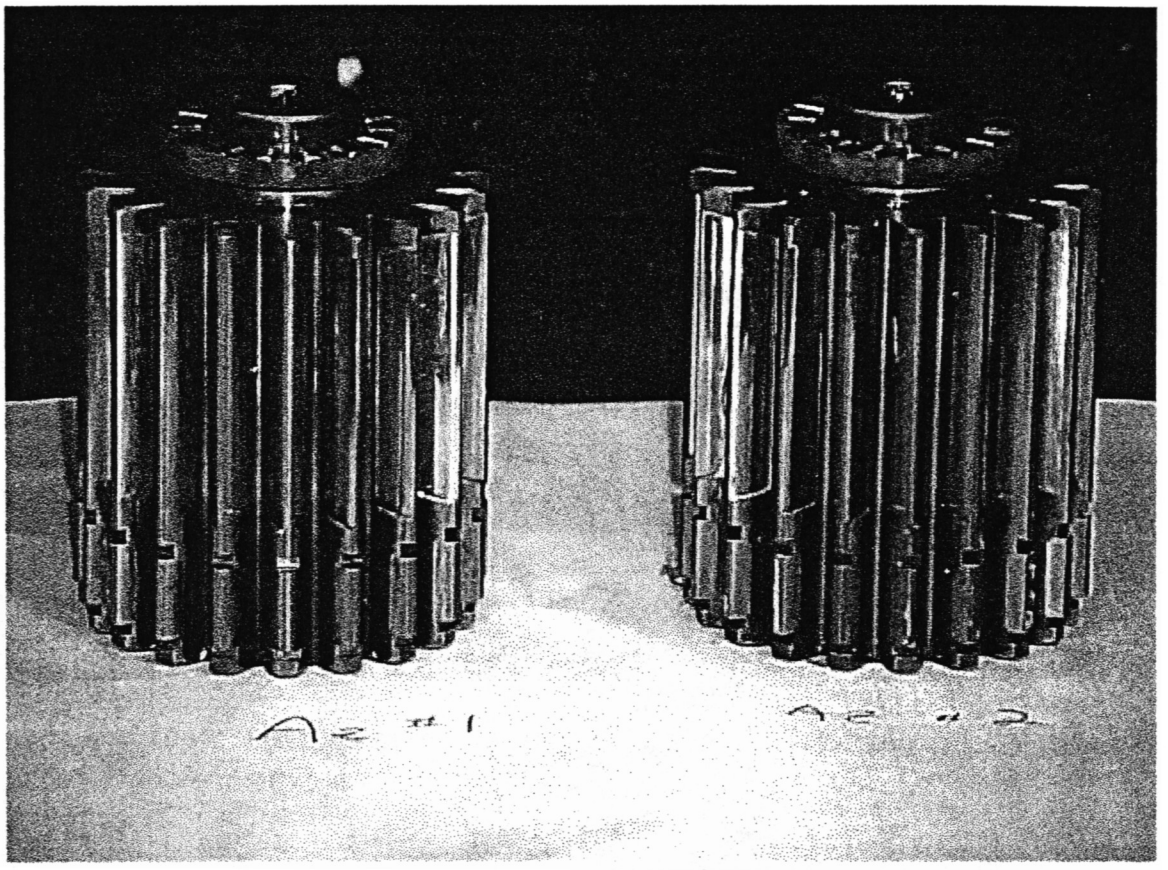
**Conclusions:**

The sun gears and thrust bearings on both gearboxes showed signs of wear. The 1st stage thrust bearings in Az#1 gearbox were in very poor condition. The thrust bearings in Az#2 gearbox did not look as worn. The excessive wear in the Az#1 thrust bearings may have been caused by improperly sized spacers.

A groove matching the profile of the planetary gears was worn into one side of the sun gears. A typical groove is shown in the photograph below. The depth of the grooves was between 0.010 and 0.015 inches. The deeper grooves were on the latter or slower moving stages of the gearboxes. The surfaces of the grooves were very shinny, almost a lapped appearance. There were no scratches in the gear teeth that would indicate foreign particles in the oil. The fact that the slower running, higher loaded, later stage gears showed more wear than the faster running, lighter loaded, early stage gears may indicate that we should use a higher viscosity oil.



The photograph below shows that the sun gears in Az#1 gearbox are worn on the counter clockwise rotation side while the sun Gears in Az#2 gearbox are worn on the clockwise side. The sun gears show very little wear on the opposite side. This uneven wear is probably due to the 30% servo preload used to reduce backlash. If this is the case, we should be able to extend the life of the gears by reversing the direction of the preload or swapping the gears from one gearbox to another.




During maintenance visits to other sites, we will open up the gearboxes and inspect them. If these gearboxes show identical wear patterns, then we should immediately reverse the preload or the exchange the gears in the gearboxes.