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Shutter problems in Carnarvon in 2015 February

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Abstract

The shutter motor keeps tripping out, and causing the dome to become stuck open. The dome and shutter motors were swapped over to eliminate a fault with the motor. It was discovered that there was no keyway on the shutter motor shaft which was allowing the motor to slip. A second fault was found on one of the SSR relays in the relay box. A keyway was installed, and the faulty SSR bridged out. The shutter now operates correctly. Additional work was done on the weather arm, replacing the rain detector and repairing the anemometer.

1 Introduction

Steven Hale and Barry Jackson visited Carnarvon from February 10 to 22. Two faults on the shutter mechanism were identified and repaired. The rain detector was replaced. The anemometer was given a new head and bearings.

2 Shutter Motor

The shutter in Carnarvon has been getting stuck, leaving the dome open. Both Les Bateman and Les Schultz looked at the problem, and couldn't see anything wrong with the track or rollers. The only possible identification of a fault was that when operated on manual control, the shutter motor would "stall" for a fraction of a second every few seconds. Something was clearly not right, but a solution could not be found. A visit from Birmingham was needed.

Upon arriving on site, it was noticed that both the shutter motor and the dome azimuth motor were exactly the same type — Leeson M4P17DC4A. We could swap over the two motors and determine if one of them was faulty.

Upon removing the shutter motor, it was noticed that there was no keyway on the shaft into the gearbox. There were signs on the shaft of some slippage, and yet it had been working like this for the best part of thirty years! We continued the motor swap, and installed the shutter motor onto the dome azimuth gearbox. It worked perfectly.

We purchased two keyways from "Carnarvon Steel" and fitted them to the motor when installing the old dome motor onto the shutter gearbox. This was quite tricky because the slots in the motor and gearbox shafts are not completely flat. The first attempt to install the motor resulted in the whole mechanism seizing up. It took several attempts of trial-and-error to file and shape the keyway into a custom fit for the motor. Perhaps this is why one was never installed originally! Eventually the motor was fitted and the mechanism turned freely.

Testing the new motor gave good results. It ran cleanly, and the occasional "stalling" was gone. Both motors were now operating correctly in their swapped positions.

However, when the dome was moved back onto automatic, another problem with the shutter was identified. The shutter would sometimes move very slowly. When switching back to manual control the shutter worked fine. Clearly there was a problem with the SSR relays in the relay box that send power to the motor under automatic control. The manual switches do not use these relays, and so that explains the difference in performance between manual and automatic. When running on automatic, with the motor running slowly it would take a long time to move to the commanded position. These motors are not designed to run continuously, and they quickly heat up. Once they get too hot, the thermal cut out trips and the motor stops. The only way to reset them is to press the reset button on the back of the motor.

The shutter motor was slow in both directions when operating on automatic. There are three SSR relays that control the motor. One for up, one for down, and a third that removes power to the other two if you try to drive both up and down at the same time. Since both up and down were affected equally, it was likely that this third "safety" relay was the problem. The relay was bridged-out and indeed the fault was no longer present.

Unfortunately there were no spare SSR relays in the dome, and so the faulty relay was left bridged-out. On the next visit a new relay should be installed to replace the faulty one.

After fixing two faults, one mechanical and one electrical, the shutter is now working correctly again.

3 Rain Detector

The rain detector was replaced. Previously there had been several false alarms, with the rain detector tripping many times per day even when the weather was completely clear.

The cabling for the weather arm was last worked on in 2007 February, and the wiring for the rain detector is shown in figure 4 of BTR282 [1]. However that diagram contains a mistake, there is no violet wire the DRD-11A is only a 7-wire device. The diagram from Sutherland by Brek Miller in BTR314 [2], figure 7, is correct.

The new rain detector was wired as in BTR314 [2].

The number of false alarms has reduced dramatically, but the sensor still seems to trip more often than it should. It doesn't rain that often in Carnarvon. Possibly there is an additional fault on the weather module. This should be investigated on the next visit.

4 Anemometer

The anemometer was missing all three of its cups. A new head was installed, along with new shaft bearings. When the anemometer was re-installed, it didn't work. The weather module indicated a wind trip permanently.

Further investigation revealed that some of the pins on the MIL connector inside the anemometer were broken. The sensor uses a panel-mount MIL connector, but it is not mounted to anything. It is supported only by the solder connection to the main PCB. Since the external connector had been in place for many years, it had become tight and the force required to remove it had clearly broken the pins.

Luckily, there is just enough space between the PCB and the connector to reach in with a soldering iron tip. The broken pins were re-soldered, and all pins built up with more solder to provide increased mechanical support. When the anemometer was re-installed, it was working correctly.

The weather module has a test point output for the anemometer. Looking at this with an oscilloscope revealed a variable frequency square-wave, which is the expected output. No attempt was made to manually spin the anemometer and check the weather module trips above a certain limit. But the sensor itself is definitely working.

References

[1] Ian Barnes, Brek A. Miller, and Barry Jackson. The removal of Jabba from Carnarvon in 2006 November. *BISON Technical Report Series,* Number 282, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, February 2007.

[2] Brek A. Miller. The implementation of separate top/bottom oven temperature control in Sutherland in 2008 November. *BISON Technical Report Series,* Number 314, High-Resolution Optical-Spectroscopy Group, Birmingham, United Kingdom, January 2009.