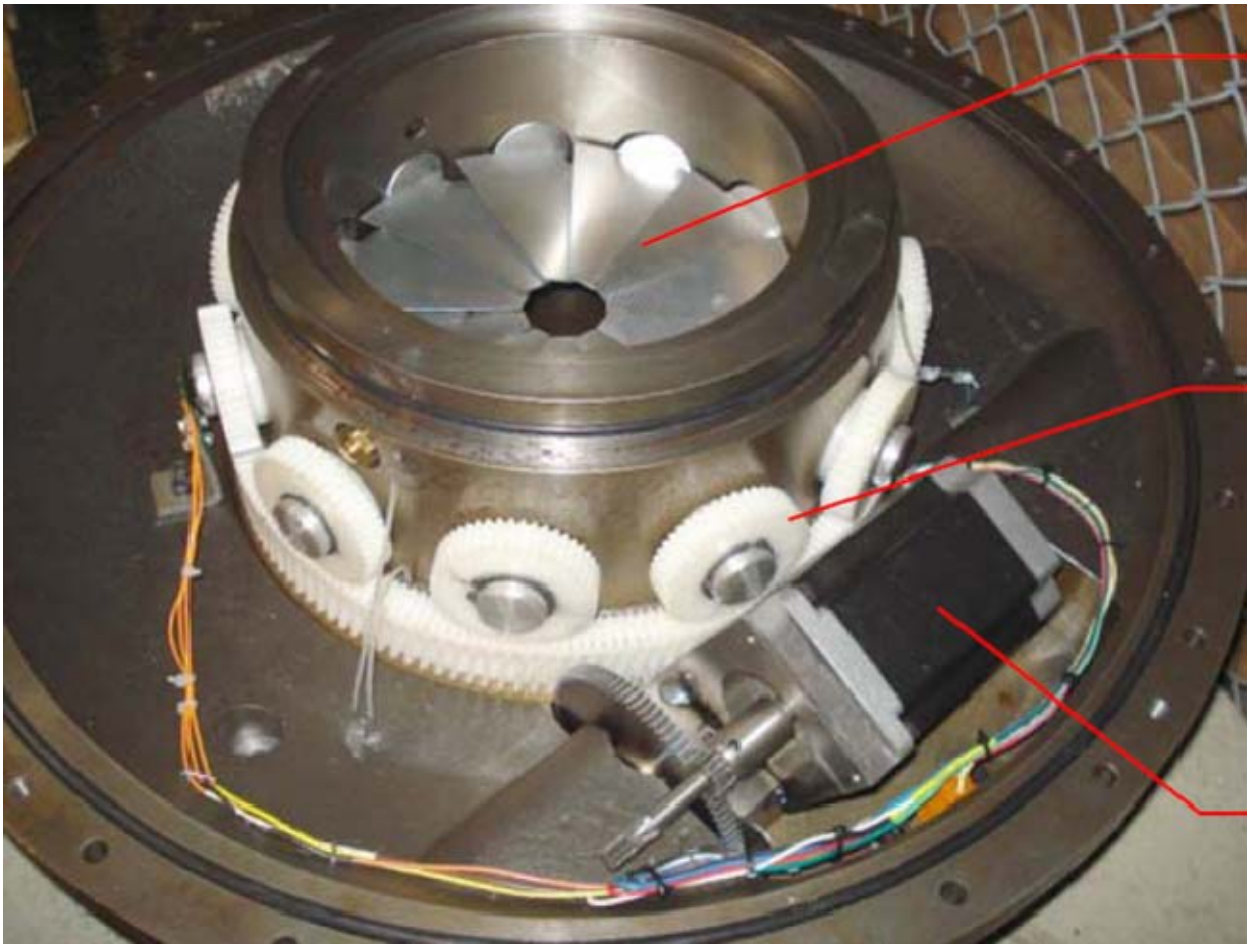
Virginia Military Institute

CEC Project

McQuay Inlet Guided Vane System



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McQUAY IGV SYSTEM DESIGN

1.0 ABSTRACT

McQuay International has designed an inlet-guided-valve (IGV) gear/motor system to be used inside of a compressor to open and close flow-regulating fins. The VMI CEC team was asked by McQuay to determine the life of the gears using a maximum fin torque of 100 ft-lbs and to determine the accelerated life factor for the system based on accelerated stresses.

As can be seen in Figure 1.1, the IGV gear/motor system consists of five gears from the motor to the fins. The gears (and the material they are made from) are: Pinion Gear (Steel), Bull Gear (Delrin), Helical/Face Gear (Delrin), and IGV Gears (Delrin). The purpose of the gears is to adjust the fin opening angles on the valve to control the amount of gas that flows into the compressor. When sensors installed on the system send the signal to open/close the valve, the motor starts and delivers a torque that moves through the gear train, to turn the fins.

McQuay was looking for a system that doesn’t require lubrication since the IGV is installed inside the compressor and it would be troublesome to lubricate the gears inside the compressor. Therefore the Bull Gear, Helical/Face Gear, and IGV Gears are made out of Delrin, a plastic material that self lubricates as the surface receives contact. The placement of the Delrin gears is arranged to provide sufficient lubrication for the whole system.

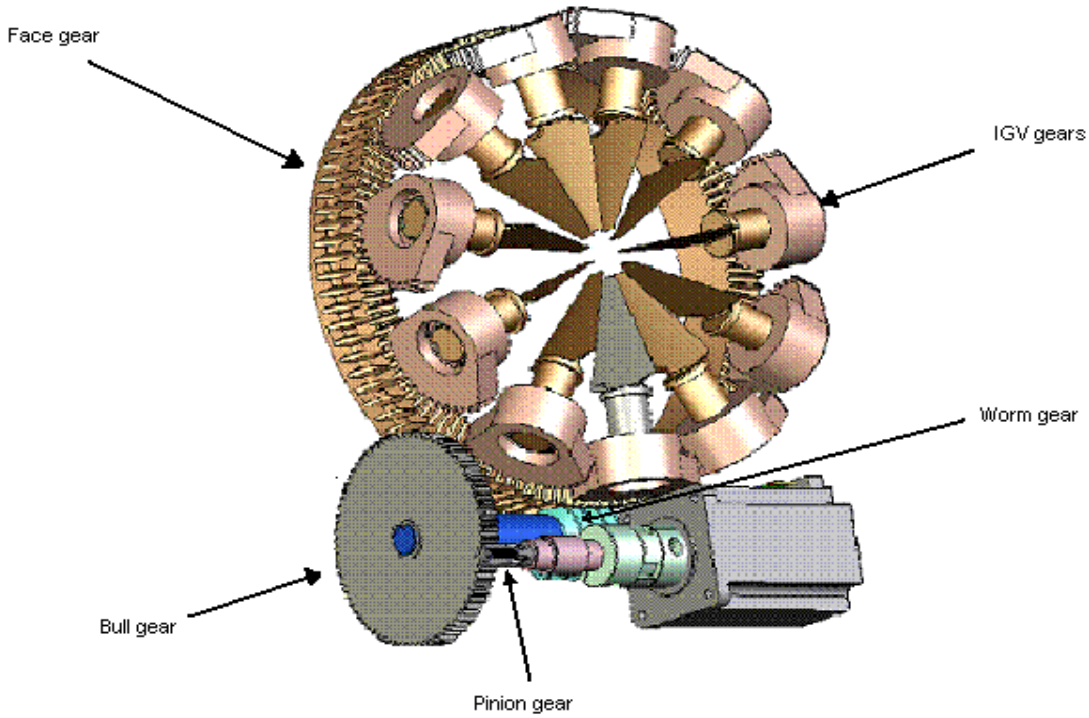

Figure 1.1

Our design team was tasked to provide McQuay with a gear analysis of all gears in the IGV system, using appropriate AGMA analysis methods, based on the torque ratio of the gears and the fin torque on the fins, caused by the gas load on the vanes at the fully closed (-90^0)position to determine:

- The motor torque capability.
- The forces/stresses on the gear teeth, based on the maximum fin torque on the vanes.
- The life of the gears under a) the current maximum fin torque, and b) an increasing fin torque.
- The weakest link/the limiting factor to gear life in the IGV system.
- The accelerated life factor for the system based on a use life of 30,000 fin cycles.