



Backlash- and Vibration-Free Gearing Improves Tomography Imaging

For the rotational machines used to gather dental X-ray images, motion chatter can produce a fuzzy image, which is not suitable for diagnostic purposes.

Vantage's Panoramic X-ray system with the C-Arm that holds the lasers as well as the removable CCD receptor.

As a panoramic radiographic device, the Vantage Panoramic X-ray System, designed and manufactured by Progeny incorporates a DC X-ray source, CCD digital receptor, distributed processing circuitry, and an LCD touchscreen control panel for ease of use. What makes the Vantage system unique is that it is adjustable to the patient's height via a motorized, 3-speed, telescoping column. The use of multiple lasers is to locate the patient and configure the device to the patient's morphology. In addition, a workstation coordinates the individual processors.

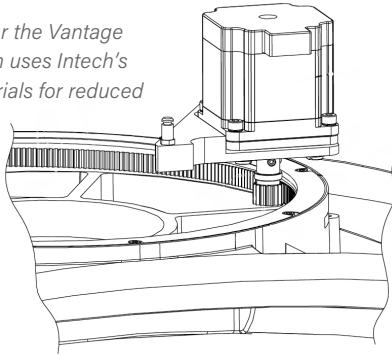
The system incorporates an overhead, swing arm (lateral Y-axis) that supports a C-arm, which is the rotating member that moves around the patient's head. The C-arm includes a tube-head, which produces the X-ray beam, and a removable CCD sensor, which is the digital image receptor. If this arm does not operate smoothly, a distorted image results.

The swing arm pivots on bearings located in the mounting casting fastened at the top of the column. Producing its motion is a ball screw drive, one end of which connects to the mounting casting and the other end to the swing arm. A step motor mounts at the column end. Both mechanical connections of the drive assembly are through ball bearing assemblies.

Suspension of the C-arm is on a pair of bearings mounted to the underside of the X-axis translation plate. The C-arm casting incorporates a 10" ID internal tooth ring gear that meshes with a **pinion gear** on a step motor mounted on the stationary X-axis translation plate. The motor is spring-mounted to maintain positive mesh and to minimize slop. The internal ring gear and pinion are sized and shaped to engage on the inside surface of the C-arm. With activation of the motor, the stationary pinion engages the teeth in the internal ring gear causing rotation of the C-arm.

The engineering team at Progeny worked with Intech to help design the C-arm casting and its interface with the gear drive for the C-arm's rotation. Design of the company's Power-Core products is specifically to reduce noise and vibration and run without lubrication, an important factor (a must) for medical equipment designers. Intech components are far lighter in weight

The precision gearing for the Vantage Panoramic X-ray System uses Intech's Power-Core nylon materials for reduced chatter, resulting in clearer images from the system.



than metal parts and offer longer life (less wear) and lower maintenance costs. Intech engineers used a proprietary gear load/life calculation to verify that the gears designed into the dimensionally restricted place would last at least 8,000 hours of operation or about 15 years in field use.

The challenge was to design a **backlash free gear** to produce a steady rotational movement of the image producing components. There was no room to employ the traditional split gear design. To eliminate backlash, installation of a spring, on slight angle relative to the axis connecting the gear centers attached to the pinion, pulls the pinion toward the 10" ID internal ring gear. The spring arrangement did eliminate the backlash, but caused the gear teeth to bottom out, resulting in chatter. The chatter registered on the X-ray image.

Drawing on its expertise in **gear design**, Intech engineers designed and precision-machined the pinion and the internal gear to incorporate a special contact surface, which allowed the components to control the center-to-center distance between the inner tooth gear and the motor pinion. Adding the center-to-center distance management element presented a method for precise gear positioning in the mesh, and drastically reduced system vibration generated by the spring force and the resulting bottoming out of the gear teeth in the earlier design.

This configuration provides precise control over gear mesh vibration and backlash, resulting in high image quality in both a clockwise and counterclockwise rotation of the C-arm. It also adds a robust design element, which helps to increase product life so that image quality does not degrade with component wear and tear. With no fuzzy imaging due to chatter, dentists can make better diagnosis and provide better service to their customers.

Power-Core Medical Equipment Applications

Power-Core, a proprietary polymer based on the laurolactam resin used in nylon 12 production, has a unique balance of properties that make it well-suited to medical equipment applications. They are:

Shock absorption. Power-Core's unique properties reduce vibration in imaging machines, particularly when they need backlash-free gears.

Self-lubrication. No lubricant is required with Power-Core, which increases maintenance intervals and reduces the potential for contamination.

Precision machined. Power-Core gears and rollers are precision machined. Gears are produced to AGMA 11 standards—and remain that way thanks to our material's dimensional stability. Rollers have concentricity specifications as tight as 0.015 mm.

Low inertia. Polymer motion components have an inherent weight advantage compared to metals, which translates into a low-inertia operations.

Chemical resistance. Power-Core resists all the commonly used sterilization chemicals.

Wear and abrasion resistance. Power-Core polymer motion components won't wear out expensive metal mating components, including precision ground rails and because power-core won't wear mating components it allows medical device designers to use less expensive aluminum tracks and rails.

High-load capacity. Power-Core rollers are routinely engineered to withstand many tons of force and can easily handle the biggest loads encountered on sliding and rotating imaging and operating tables.

Non-magnetic. Power-Core motion components use no magnetic components, making them MRI safe.

Non-outgassing. Power-Core meets outgassing specifications and is a good fit for laboratory equipment that runs in vacuum.

About Intech

Intech Corporation specializes in the design and manufacture of lightweight, robust, low-noise machine components that eliminate the need for lubrication. Our self-lubricating products include gears, guide rollers, cam followers and custom-designed motion components. To meet your application requirements, we employ a variety of advanced polymers, low friction coatings, metal alloys, or polymer-metal hybrid structures. We have pioneered many design solutions and support each design with advanced durability calculations, including stress simulations.

For more detailed information on our engineering capabilities, check out our latest white papers and case studies.

Durable, Self-Lubricating Polymer Bearing Surface Excels in Motion Systems

Learn how a polymer-based hybrid track roller design overcomes the pitfalls of traditional metals and plastics in motion systems.

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