ANTI-GRAVITY ROBOTIC ARM: A strategic industrial manufacturing solution

Overview

Robots in manufacturing plants can benefit from springs to counter forces like gravity. Kern-Liebers requires a spring specifically for an actual industrial setup where robots are engaged.

Objective

The robotic arm experiences a moment of force due to gravity. This is inefficient in terms of performance and stability. A mechanism at the shoulder joint of the robotic arm must be devised in order to counter the moment created due to gravity.

Approach

Kern-Liebers has expertise in designing and manufacturing various types of springs and recommended using a spring mechanism to solve this problem. A survey was sent to the sponsor asking specific questions pertinent to the product. The outcome was helpful in selecting the customer needs such as durability, safety and ease to manufacture and assemble.

Several patents and journal articles were researched that gave ideas to solve this problem and also meet the customer needs. Among the several concepts, four of them met the requirements and were possible solutions. Pugh chart and a concept selection score chart were generated to pick one out of these four design ideas.

Using two torsional springs at the shoulder had the highest rating and was ideal for this problem. One end of these two torsional springs was attached to a shaft such that one of the two springs is fixed while the other end transfers the force to the moment arm. The parts were designed on Solidworks and the entire spring assembly has just five parts including the two torsional springs. Finite Elements Analysis was done to ensure the shaft could withstand heavy loads ranging from 17KPa to 210MPa.

Outcomes

This spring assembly has distinctive attributes that surpass the primary customer need. The following are the outcomes of this project:
- The project was completed on time and the overall expense was less than $500, which is a 50% saving for the sponsor
- Manufacturing time is just twelve hours while the assembly time is thirty minutes
- Two torsional springs increase the range of travel. This assembly has a 180 ° range of travel
- The lifespan of this spring is over two years making it highly durable
- The shaft and spring safety factor is 2, which enhances performance even under heavy unexpected load conditions
- The spring mass is 0.5 Kg, which makes it extremely light and easy to maneuver