Three-Ring Bearings for Robots with Scissors Kinematics

Intelligent Bearing Solutions Save Space and Costs

SCHAEFFLER GROUP
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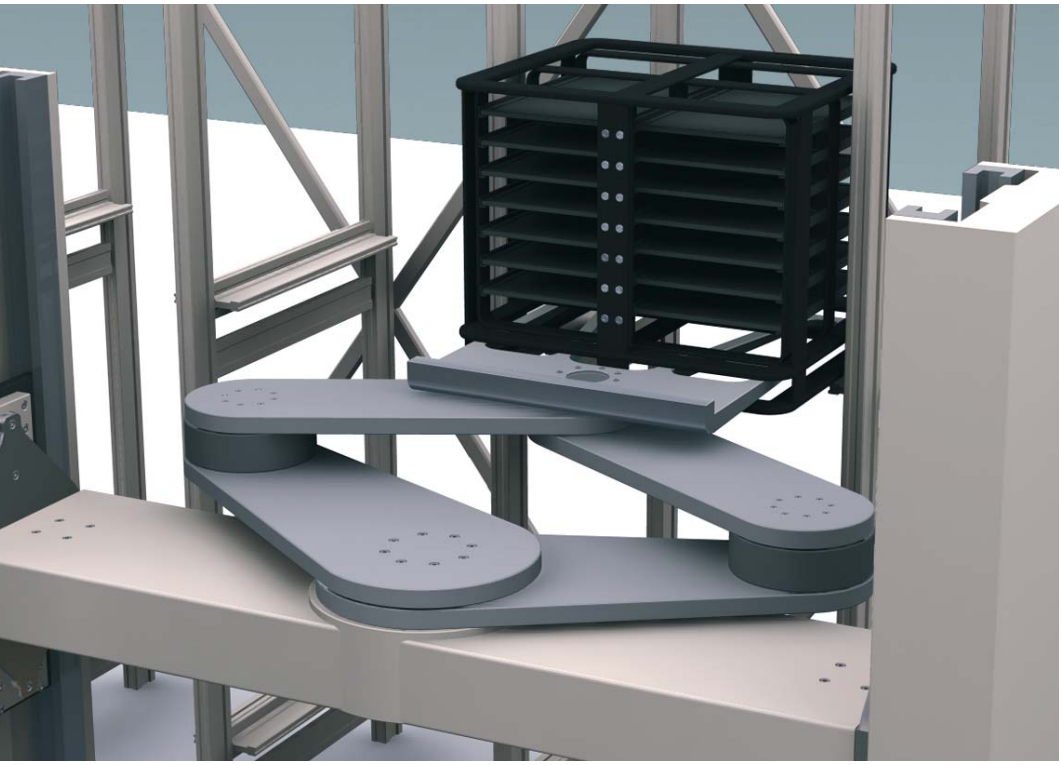
Economical



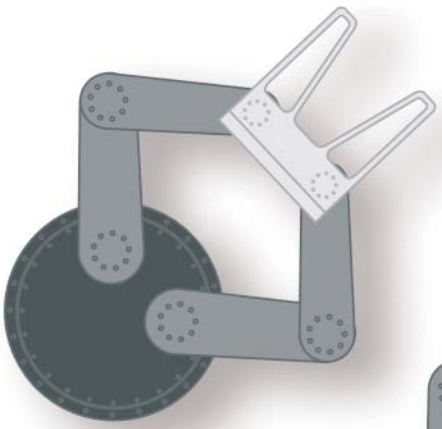
A means of reducing costs: New scissors kinematics in semiconductor manufacturing

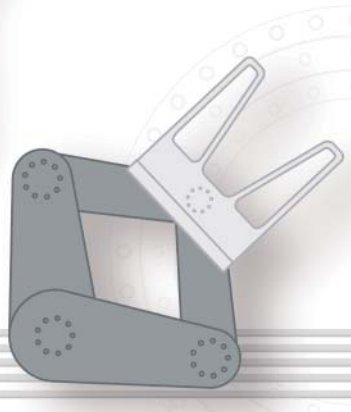
Robots with scissors kinematics are compact handling devices with long stroke. They are used in particular in semiconductor manufacturing, for example, in wafer or flat panel transfer systems.

Standard Designs Require Seven Bearings

Conventional scissors kinematics devices have two scissor-type arms from the load-holding arm that are connected to the foot joints from the wrists via intermediate pivots (elbow joints). The foot joints are mounted on a rotating footplate, which is required as an adapter between the center and foot bearings. The individual bearings are dimensioned according to the mass of the goods to be transported and the bending moment that occurs due to the lever effect between the mass center of gravity and the bearing axis of rotation. The largest moments occur on the center bearing in the extended position. This is the reason for the large diameter of the center bearing and, of course, because it has to support the two foot bearings next to each other.

Seven bearings are required for the standard design described here, along with the scissor arms, the load-holding arm and the foot plate.





Comparison of size of handling robots. Optimized version with three ring bearing on right, on left, without three ring-bearing

Solution

Three-Ring Bearings Simplify the Design

Schaeffler Group application engineers have now presented a development study (a patent application has been filed), which facilitates significant savings in terms of design space and costs.

The significant difference here is the use of three-ring bearings instead of the center bearing and the wrist and foot joints. Apart from the scissor arms, this type requires only four bearings (two standard bearings and two three-ring bearings) as mechanical components.

The bending moment that results from the lever effect between the mass center of gravity and the bearing axis of rotation is now the decisive factor for the size of the bearing in the base of the device.

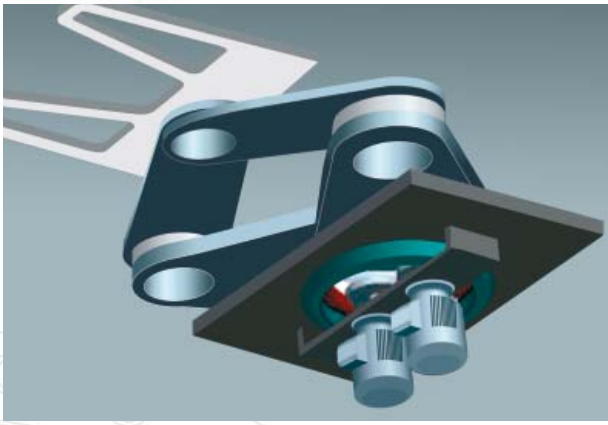
New Solution is More Economical

Using three ring bearings in handling robots with scissors kinematics provides the following advantages:

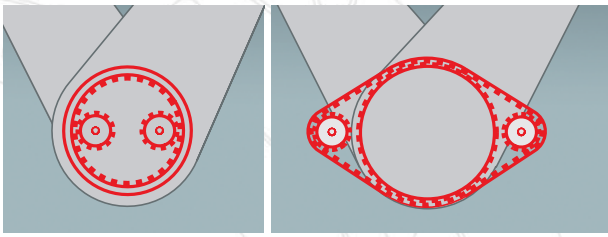
- The design requires fewer bearings and, in particular, the largest and therefore most expensive bearing for rotating the overall construction is no longer required.
- The bearings can be designed according to their loads and not due to geometrical boundary conditions.
- The reduced number of bearings and adjacent components considerably reduces the outlay required in mounting.
- The supply of electricity is now simplified, since the drives are now stationary in the base. Various types of drives, such as toothed gears, toothed belts or torque motors can be used, depending on requirements.

Simplified Drives

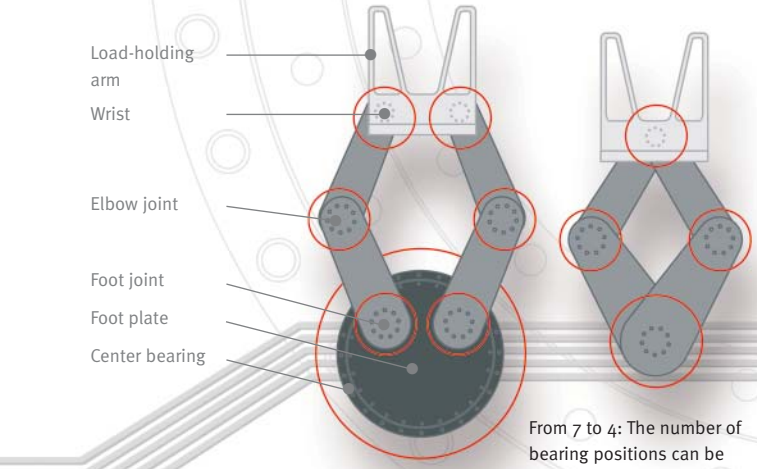
The simplified design of the drive also generates further advantages. The conventional design requires one drive for each scissor arm on the movable footplate as well as one for the rotation of the entire kinematics. The latter drive is unnecessary in the new design. Depending on the movement of the two drives in relation to each other, the entire robot can rotate or extend and retract the scissors kinematics.



Using three-ring bearings facilitates designs with stationary drives



Stationary motor positioning, for example, with bearings with internal gear teeth (left) or with toothed belts and bearings with external gear teeth



From 7 to 4: The number of bearing positions can be significantly reduced

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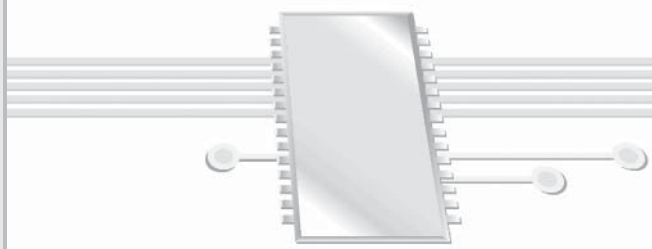

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