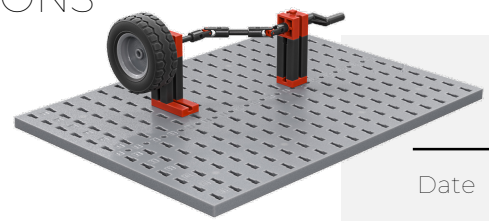
Model 4
Cardan shaft



Date

Name

Class

The students are supported in individual tasks by the provision of construction instructions (see appendix) for the construction and solution of the tasks. For tasks where this is appropriate, this is indicated at the beginning of the solution sheet.

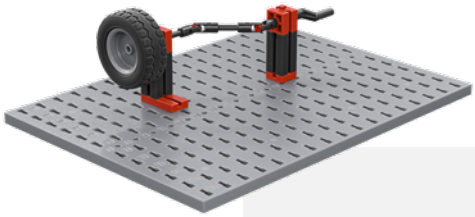
Note on the history of technology: The name "Cardan joint" refers to the Italian polymath and mathematician Gerolamo Cardano (1501-1576), who described what later became known as the "Cardan suspension" in his 1550 work "De Subtilitate." In fact, this suspension, also known as a "ring suspension," was already described in 230 BC by Philon of Byzantium and drawn several times around 1500 by Leonardo da Vinci (1452-1519). Cardano is not known to have published anything about the ring or universal joint derived from the ring suspension. The oldest known description of the universal joint comes from Caspar Schott (1608-1666) in his book "Technica Curiosa" from 1664.

The elimination of the Cardan error in a Cardan shaft was discovered by the English physicist Robert Hooke (1635-1703) in 1683.

The students receive a copy of the angle measuring discs to cut out.

CONSTRUCTION TASK

The drive shaft and output shaft meet at an angle of approximately 119°.



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THEMATIC TASK

Rotation angle Drive	Output rotation angle	Δ	Drive rotation angle	Output rotation angle	Δ
0°	0°	0°	90°	90°	0°
15°	17°	2°	105°	95°	-10°
30°	42.5°	12.5°	120°	102.5°	-17.5°
45°	57.5°	12.5°	135°	115°	-20°
60°	70°	10°	150°	125°	-25°
75°	77.5°	2.5°	165°	150°	-15°
90°	90°	0°	**180°**	180°	0°

EXPERIMENTAL TASK

1. The maximum adjustable angle of the universal joints (smallest angle between the drive and center sections of the cardan shaft) is approx. 117°.
2. The cardan errors cancel each other out.
3. Alternative transmissions are, for example,
    - a gear transmission (two gears of equal size on the drive and output shafts, with any gear in between to prevent a reversal of direction),
    - a chain or belt transmission. The disadvantage of the gear transmission is the loss of efficiency (up to 10%), while the disadvantage of the belt transmission is the force-fit connection. Chain transmissions have a significantly lower maximum speed than gear transmissions (factor 10 to 30).

APPENDICES

Building instructions and templates for the transmissions and models:

Model 4: Construction manual for universal joint, sheet with angle measuring discs for the universal joint to cut out, construction manual for universal joint with angle measuring discs, construction manual for cardan shaft, construction manual for cardan