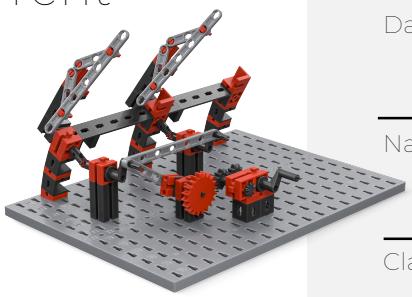
Model 14
Windshield wiper - concurrent

Date

Name

Class

The students receive the construction instructions for building the co-rotating windshield wiper.



DESIGN TASK

1. The rotation of one axis causes the other axis to rotate in the same (!) direction. This also works when the universal joint is bent and there is an angle between the axes.

2. The greater the kink angle, the more uneven the rotation transfer becomes. Above a certain limit, it no longer works at all.

THEMATIC TASK

1. The correct setting is an eccentricity of a few millimeters. This can be easily determined by trial and error.

2. The crank must be turned twice so that the windshield wipers move up and down exactly once. This is due to the reduction ratio Z10 to Z20 (in short: 10:20) in the gear mechanism: One turn of the crank, i.e., one revolution of Z10, also moves Z20 by 10 teeth—i.e., only half a revolution. To achieve one revolution of Z20 and thus one wipe cycle, you have to turn Z10 and thus the crank twice.

3. Regarding the overlap of the wipers:
   a) The wiper on the right-hand side of the gearbox (on the "inside" of the vehicle) must be at the bottom, and the left-hand wiper at the top.

   b) If the right wiper were on top, the left wiper could no longer be raised – it would be blocked by the right wiper below.

   c) The end of the right wiper blade closest to the pivot point moves only slightly up and down. However, the end of the left wiper blade furthest from the pivot point moves a long way (it describes a large circular path around the pivot point). The right wiper blade does not allow this large movement. Therefore, the left wiper blade must be on top.

EXPERIMENTAL TASK

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1. The direct drive of the Z20 by the crank Z10 causes a reversal of the direction of rotation of the Z20 when cranking. However, this does not change the rotational speed – the reduction ratio remains 10:20.

2. Above a certain eccentricity, the possible swivel range of the cranks is no longer sufficient for the offset range of the eccentric. The model then locks up. The wiper blades can only be moved back by cranking in the other direction. However, this means that the purpose of the eccentric – to convert a uniform rotary motion into a back-and-forth or swiveling motion – is no longer fulfilled.

3. Manual pivoting of the wipers allows the wiping motion to be performed, but the crank itself then also rotates back and forth. The eccentric cannot move beyond its extreme positions (the "dead centers").
   This mechanism therefore only works in one direction: drive at the crank, output at the wipers.

APPENDICES

Further information

[1] Wikipedia: Spur gear.

[2] Wikipedia: Eccentric.

[3] Wikipedia: Coupling gear.

[4] Wikipedia: Universal joint.