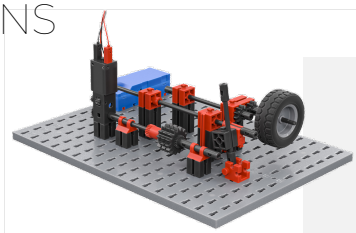


Model 5
Manual transmission

Date

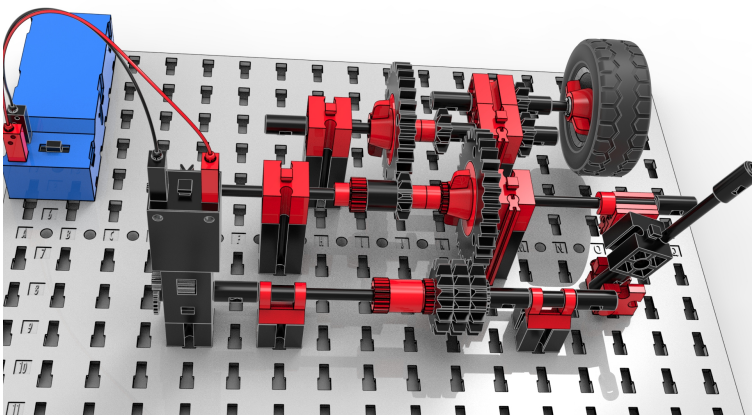
Name

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.

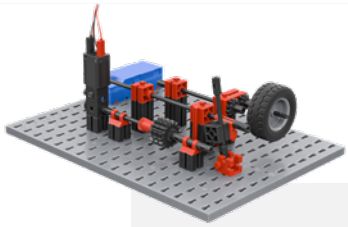
Students receive the assembly instructions for the basic construction of the manual transmission.

CONSTRUCTION TASK



THEMATIC TASK

1. The shift shaft in the illustration translates 1:3 into slow mode and 3:1 into fast mode. In addition, the drive shaft translates to the shift shaft at a ratio of 1:2 into slow mode. In first gear, the manual transmission therefore translates 1:6 into slow mode and in second gear 3:2 into fast mode. The rotational speed of the output shaft differs by a factor of 9 in both gears.



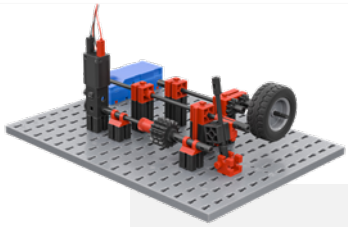
Date

Name

Class

2. There are numerous alternative design options:

- With two Z20s, one of the two gear ratios of the shift shaft can be replaced by a 1:1 gear ratio. The rotational speed of the output shaft then differs by a factor of 3 in both gears.
- With two Z10 and two Z40, a 1:4 and a 4:1 gear ratio (slow and fast, respectively) can be achieved; the rotational speeds then differ by a factor of 16.
- If one of the two gear pairs in the latter gearbox is replaced by two Z30s, the 1:4 or 4:1 ratio can be replaced by a 1:1 ratio. The rotational speeds of the output shaft then differ by a factor of only 4.
- With two Z15 and two Z30 or two Z10 and two Z20, a gearbox with a 1:2 and a 2:1 transmission ratio can be constructed; the rotational speeds of the output shaft also differ by a factor of 4 in this gearbox.
- A gear train with two Z15 and two Z10 provides ratios of 3:2 and 2:3; the difference in the rotational speeds of the output shaft in this design is 9:4 (i.e., a factor of 2.25).
- With two Z15 and two Z20, you get a 3:4 and a 4:3 transmission ratio; the difference in rotational speeds for this gear arrangement is a factor of 16:9 (i.e., approximately 1.8).
- With two Z15 and two Z40, you get a 3:8 and an 8:3 transmission ratio; the rotational speeds of the output shaft differ by a factor of 64:9 (i.e., approximately 7.1).



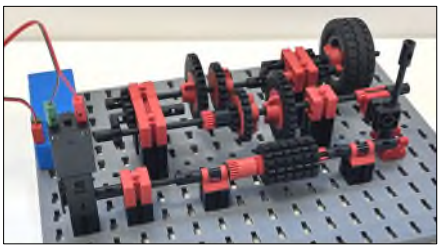
EXPERIMENTAL TASK

Date

Name

Class

1. The following three-speed manual transmission (with two Z30, two Z20, and two Z10) achieves gear ratios of 1:3, 1:1, and 3:1.



With two Z40, two Z30, and two Z20, the gear ratios 1:2, 1:1, and 2:1 are possible.
The same gear ratios can also be achieved (in a much more compact form) with two Z10, two Z15, and two Z20.

2. The reverse gear (direction reversal!) with a 1:1 transmission ratio is formed by the three Rast-Z10 gears on the left of the picture. The middle gear can be replaced by any other gear and placed higher or lower to connect the two outer Rast-Z10 gears.

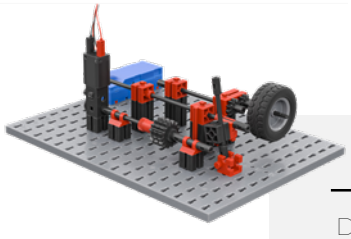
Note: Changing the gear ratio from the drive shaft to the shift shaft and the final gear ratio to the output shaft (constant 1:1 in the above transmission examples) allows a complete manual transmission to be dimensioned:

If the optimum speed range of the motor and the speed range to be covered are known, the required overall transmission ratio of the manual transmission can be calculated accordingly and the design of the transmission can be derived from this.

APPENDICES

Building instructions and templates for the transmissions and models:

Model 6: Assembly instructions for the basic construction of the manual transmission, assembly instructions for the two-speed manual transmission, assembly instructions for the three-speed manual transmission with reverse gear



Date

Name

Grade

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Building instructions and templates for the models:

Model 20: Building instructions for centrifugal governor model.

Further information

[1] Wikipedia: Centrifugal force

[2] LeifiPhysik: Centrifugal governor

[3] studyflix: Centrifugal force