Belt drive (Item No.: P1254300)

Curricular Relevance

Area of Expertise: Physik
Education Level: Klasse 7-10
Topic: Mechanik
Subtopic: Kräfte, einfache Maschinen
Experiment: Riemengetriebe

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	1 Student

Additional Requirements:

Experiment Variations:

Keywords:

Principle and Equipment

Principle

Demonstrate the construction and mode of operation of a belt drive using a single-stage belt drive.

Equipment

Position No.	Material	Order No.	Quantity
1	Demo Physics board with stand	02150-00	1
2	Axle on fixing magnet	02151-04	2
3	Wheel and axle	02360-00	1
4	Rubber bands, 50 pieces	03920-00	1
5	Marker, black	46402-01	1

Set-up and procedure

Set-up

- Screw the axles out of their respective threaded holes. Slip one of the pulleys from the wheel and axle onto each of them and screw the axles on
tight again.
- Place the fixing magnets onto the demonstration board in such a manner that the rubber band which is placed into the groove of the pulleys has sufficient tension and still allows the pulleys to rotate easily. The index marks (dots) on the pulleys should be in a position which is easy to remember (Fig. 1 a).
- Affix the crank to the large pulley and then turn the pulley through one revolution. While doing so, pay attention to the movement of the two index marks as weil as to the rotational directions of the pulleys.

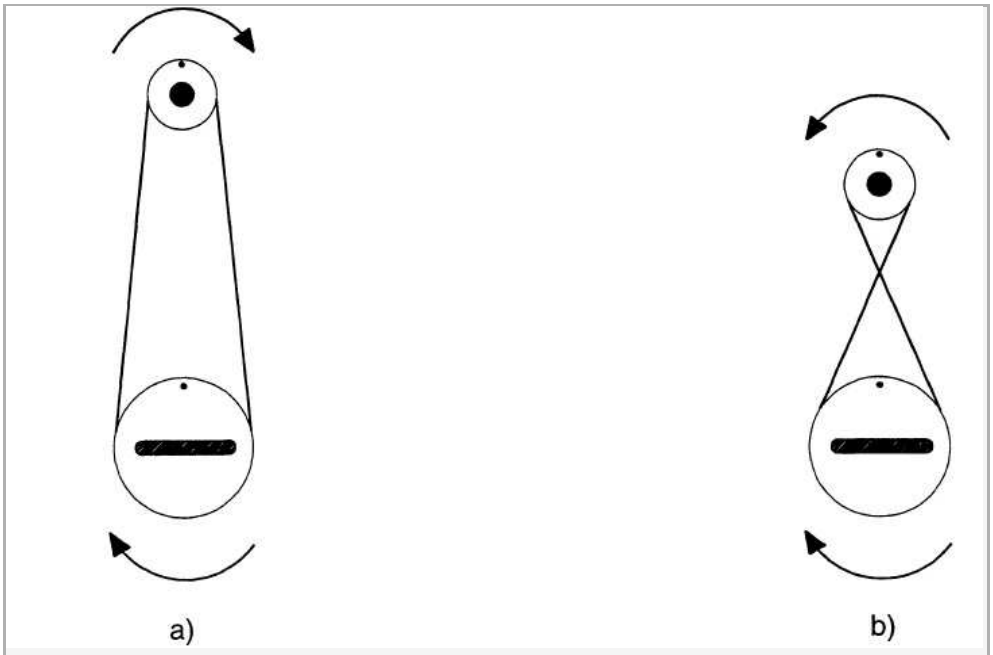

Fig. 1

Procedure

- Draw arrows on the board with the white board pen to indicate the rotational directions (Fig. 1).
- Make a statement describing your Observations (1).
- Affix the crank to the small pulley and also rotate the crank in different directions.
- Note your observations.
- Remove the rubber band and replace it in a crossed configuration (Fig. 1 b). To achieve this move one of the axles on fixing magnet slightly until the band is sufficiently taut and the pulleys can still be easily turned.
- Perform this belt-drive experiment in a manner analogous to that described above.
- Record your Observations (2).

Observations and evaluation

Observations

1. The small pulley rotates twice as fast as the large one. The rotational directions of the two belt pulleys are the same. If the I arger belt pulley is driven by the small one, the rotational directions are also the same and the driven large belt pulley turns half as fast as the small one.
2. With a crossed belt, the same is true for the rotational speed as without the belt being crossed. However, the rotational directions of the two belt pulleys are now opposite.

Evaluation

Belt drives serve to transmit force, and the transmission and conversion of rotational movements. In the process, the belt transmits torque from one belt pulley to the other.

The transmission of force occurs through frictional contact between the belts and the running faces of the belt pulleys. For the transmission of force the
transmission ratio i is decisive: $i = n_{tr}/n_g$

where

n_{tr} = Rotational speed of the driving belt pulley and

n_g = Rotational speed of the driven belt pulley.

If *N* is the number of revolutions of a belt pulley during the time *t*, then the following is valid:
$n = N/t$ and therefore $i = N_{tr}/N_g$.

Fora non-slip belt drive, the circumferential velocity of the two belt pulleys is equal:

$v_{tr} = v_g$.

As a consequence, the following is true:

$\pi * d_{tr} * n_{tr} = \pi * d_g * n_g$ (d = diameter).

It follows that:

$N_{tr}/n_g = d_g/d_{tr} = i$.

The transmission ratio can thus be determined from the diameter of the diameters of the driven and the driving belt pulleys.

In the experiment performed, d_1 = 70 mm and d_2 = 35 mm; thus the ratio $d_1/d_2 = 2/1$. As a consequence, the small belt pulley rotates twice as fast as the large one, regardless of whether it drives or is driven.

The transmission ratio first has a value of 1/2 and then 2/1 in the experiment.

Remarks

The transmission ratios 2/1 = 2 and 1 /2 = 0.5 were not exactly achieved in the experiment for the following reason:

The running surfaces for the drive belts are approximately 0.5 mm deep, thus the ratios of the diameters are approximately 2.03 and 0.49, respectively.

Die beiden im Versuch demonstrierten Getriebe bezeichnet man auch als offenes und gekreuztes Riemengetriebe.

The two belt drive mechanisms demonstrated in this experiment are termed open and crossed belt drives. Belt drives have the advantage that rotational movement can be transmitted between two shafts which are relatively far apart. Compared to the interlocking gear drive, they have the disadvantage that in the transmission of large torques slippage can occur.

The students are familiar with technical applications of belt drives from photographs of older factories as weil as from the belt-driven crankshaft generator/alternator in cars.

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