

HM 270

Impulse turbine



Description

- characteristic behaviour of an impulse turbine with air flow
- optimal view of the operating area of a turbine
- load applied by band brake

In impulse turbines, the working medium has the same static pressure in front of and behind the rotor. The conversion of pressure energy into kinetic energy takes place in the fixed nozzles of the distributor, not at the turbine rotor. This compressed-air driven experimental unit can be used to understand turbines powered by steam or water.

The HM 270 is a single-stage, axial impulse turbine. The turbine consists of a rotor that is installed inside a transparent housing, a distributor with four nozzles and a band brake for applying a load to the turbine. The number of active nozzles can be adjusted by means of the valves. The compressed air velocity is increased in the nozzles. The air flow that hits the blades generates an impulse that causes the rotor to start moving.

The inlet and outlet pressure at the turbine are indicated on manometers. The turbine torque is determined by measuring the force on the band brake. The speed is measured with an optical speed sensor. Torque, speed and temperatures are digitally displayed. The air flow rate is measured with a rotameter and set by means of a valve.

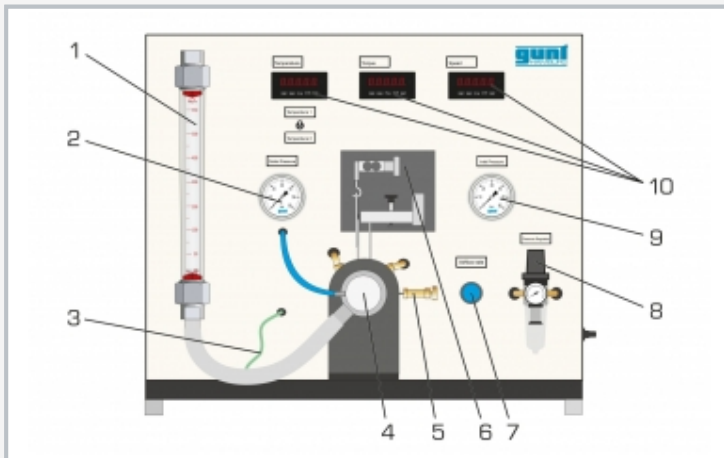
The turbine is fitted with a solenoid valve as a safety device in case of overspeed. The brake drum on the turbine shaft is cooled by the compressed air.

Learning objectives/experiments

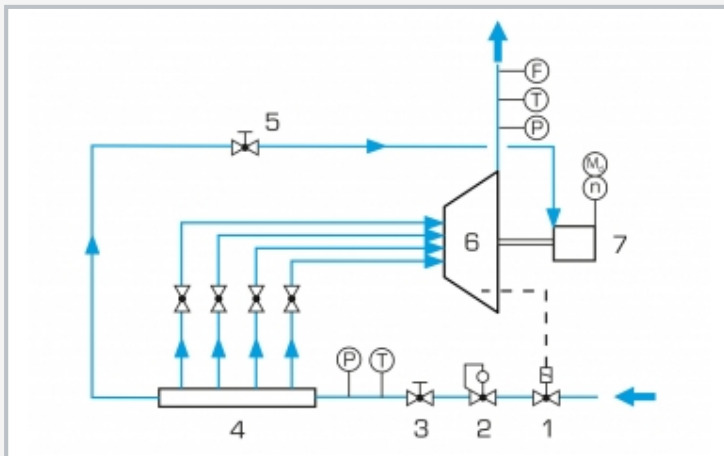
- design and function of an impulse turbine
- determination of torque, power and efficiency
- graphical representation of characteristic curves for torque, power and efficiency
- investigation of the effect of nozzle pressure and number of nozzles

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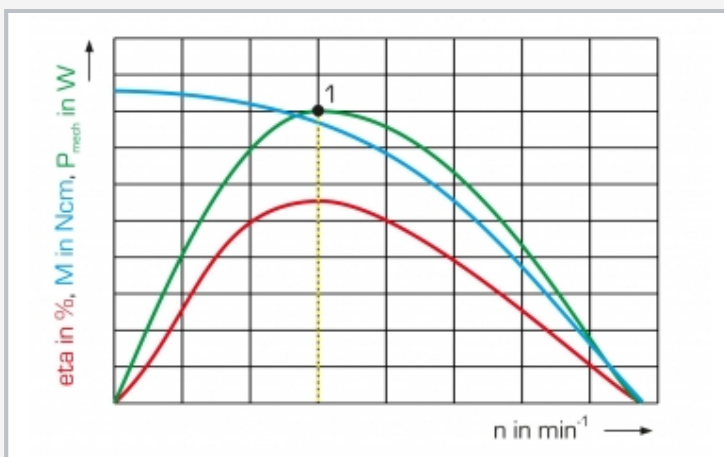
Impulse turbine



1 flow meter, 2 outlet manometer, 3 temperature sensor, 4 turbine, 5 shut-off valve for air cooler, 6 band brake with torque measurement, 7 valve for setting the flow rate, 8 pressure reducing valve with filter, 9 inlet manometer, 10 displays



1 solenoid valve as a safety device, 2 pressure reducing valve, 3 valve for setting the flow rate, 4 compressed air distributor, 5 shut-off valve for air cooler, 6 turbine, 7 band brake; P pressure, T temperature, F flow rate, n speed, M_t torque



Operating behaviour and operating point of the impulse turbine
eta efficiency (red), M torque (blue), P_{mech} mechanical power (green), n speed; 1 operating point

Specification

- [1] investigation of a compressed air driven axial impulse turbine
- [2] transparent front panel for observing the operating area
- [3] distributor with 4 nozzles
- [4] selectable number of nozzles
- [5] applying a load to the turbine by using the band brake
- [6] setting the primary pressure with the pressure reducing valve
- [7] valve and flow meter for setting the flow rate
- [8] solenoid valve as a safety device to prevent over-speed
- [9] determination of the torque on the turbine shaft using a force sensor
- [10] measurement of the turbine speed with an optical speed sensor
- [11] manometer for displaying pressures on the inlet and outlet side
- [12] digital display of speed, torque and temperature

Technical data

Axial impulse turbine

- max. power: 50W at 15000min⁻¹

Rotor

- diameter: 55mm
- number of blades: 28

Stator

- 4 nozzles, number can be selected
- entry and exit angle: 20°

Measuring ranges

- temperature: -20...1100°C
- speed: 0...40000min⁻¹
- torque: 0...10Ncm
- flow rate: 25...315L/min
- inlet pressure: 0...2,5bar
- outlet pressure: 0...0,1bar
- primary pressure: 0...10bar

230V, 50Hz, 1 phase

230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase

UL/CSA optional

LxWxH: 780x370x660mm

Weight: approx. 35kg

Required for operation

Compressed air supply 6...10bar, max. 300L/min

Scope of delivery

- 1 experimental unit
- 1 hose with pressure connection
- 1 set of instructional material

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Optional accessories

020.30009

WP 300.09

Laboratory trolley