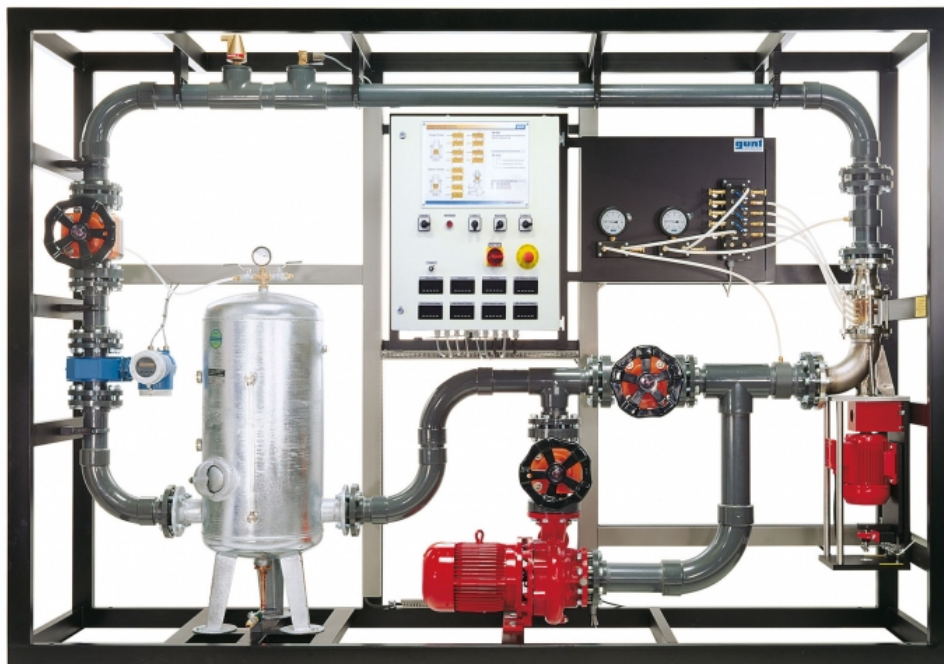


HM 405

Axial-flow turbomachines



Description

- investigation of a single-stage axial turbomachine
- can be operated as pump or turbine by changing rotor, impeller and stator, guide vane system
- probe to determine flow conditions at inlet and outlet of rotor, impeller and stator, guide vane system
- transparent working area

The core piece of the experimental plant is the axial turbomachine with attached asynchronous motor. It can be operated either as a pump or turbine. To this end, different rotors, impellers and stators, guide vane systems are used. Included in the scope of delivery are four rotors, impellers and four stators, guide vane systems supplied with different blade, vane angles. The experimental plant contains a closed water circuit with expansion tank and centrifugal pump. The compressed-air powered expansion tank allows the turbomachine to be converted without loss of water.

The asynchronous motor functions during turbine operation as a generator, and during pump operation as a drive. A powerful pump generates flow and pressure during turbine operation. The power that is generated by the turbine is fed into this pump.

The transparent housing allows a full view of the rotor, impeller and stator, guide vane system and flow processes. The 3-hole probe can be used to measure the direction and velocity in the flow field directly upstream of, between, and downstream of rotor, impeller and stator, guide vane system. These values are used to record the velocity triangles for the blade, vane shapes.

Operation under different pressure levels is possible in order to study cavitation.

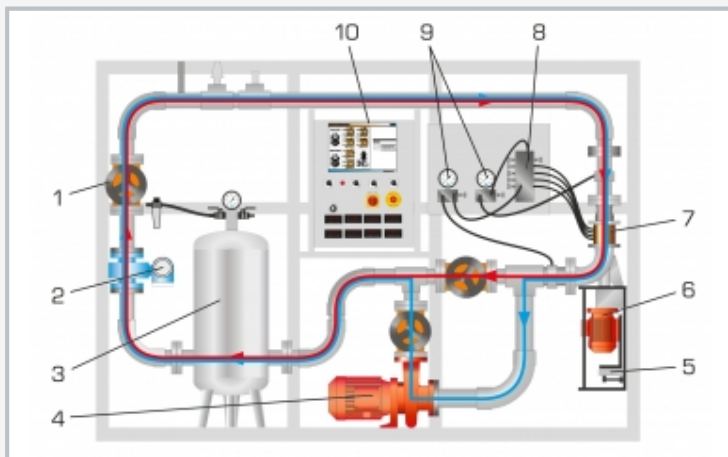
The speed is detected contact-free by means of an inductive displacement sensor on the motor shaft. To determine the drive power, the asynchronous motor is mounted on swivel bearings and equipped with a force sensor to measure the drive torque. Manometers measure the pressures at inlet and outlet. Pressure sensors measure the differential pressures at rotor, impeller and stator, guide vane system. The flow rate is measured by an electromagnetic flow meter. The measured values are read from digital displays.

Learning objectives/experiments

- recording characteristic curves
- determining dimensionless characteristics
- velocity triangles and pressure curves
- investigation of energy conversion within the turbomachine
- how blade, vane shape affects power and efficiency
- determining the outlet angular momentum and its effect on the power
- cavitation effects

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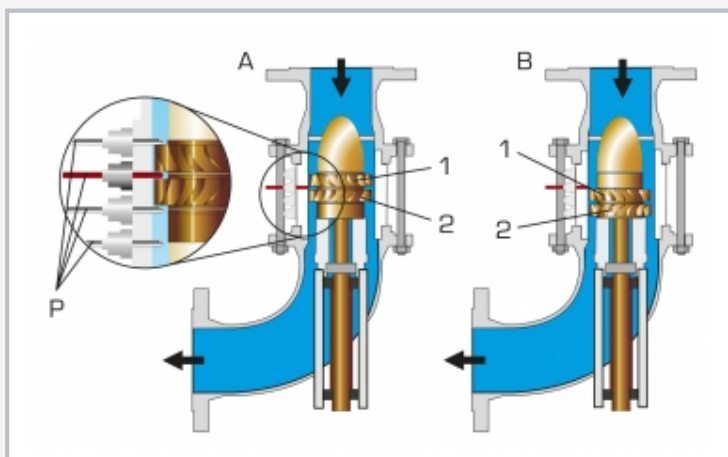
Axial-flow turbomachines



1 valve for adjusting the flow, 2 flow meter, 3 expansion tank with air cushion, 4 centrifugal pump for turbine mode, 5 force sensor for measuring the torque, 6 asynchronous motor, 7 axial-flow turbomachine, 8 differential pressure sensor, 9 manometer, 10 switch cabinet; red: pump mode, blue: turbine mode



The illustration shows cavitation effects in the working area of the axial flow turbomachine



A: axial flow turbomachine as a turbine, 1 stator, 2 rotor;
B: axial flow turbomachine as a pump, 1 impeller, 2 guide vane system;
P pressure sensor

Specification

- [1] investigation of an axial flow turbomachine
- [2] closed water circuit with expansion tank and centrifugal pump
- [3] turbomachine may be operated as a turbine and as a pump
- [4] two sets of impellers and guide vane systems for pump mode and two sets of rotors and stators for turbine mode with different inlet and outlet angles
- [5] asynchronous motor with 4-quadrant operation via frequency converter
- [6] recovery of the brake energy
- [7] motor with pendulum bearing, torque measurement via lever arm and force sensor
- [8] inductive speed sensor on the motor
- [9] manometers for measuring the inlet and outlet pressures
- [10] measuring probe and differential pressure sensor for recording the pressure curve in the turbomachine
- [11] electromagnetic flow meter
- [12] display of power consumption, torque, speed, pressure, differential pressure and flow rate

Technical data

Centrifugal pump

- power: 5,5kW
- max. flow rate: 150m³/h
- max. head: 10m

Asynchronous motor

- power: 1,5kW
- torque: 0...5Nm
- speed: 0...3000min⁻¹

Expansion tank: 150L

Measuring ranges

- pressure (manometer): 2x -1...5bar
- differential pressure: 5x 0...500mbar
- flow rate: 0...100m³/h
- speed: 0...3000min⁻¹
- torque: 0...9,81Nm

400V, 50Hz, 3 phases

LxWxH: 3300x750x2300mm

Weight: approx. 620kg

Required for operation

compressed air connection: 3...10bar

Scope of delivery

- 1 experimental plant
- 4 rotors
- 4 distributors / guide vanes
- 1 set of accessories
- 1 set of instructional material