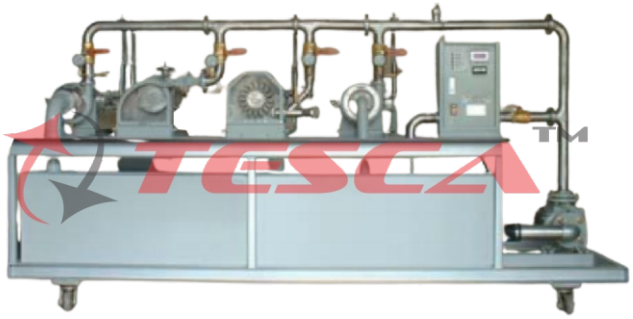

Features :

- Comparison of impulse and reaction turbines1
- Constant speeds and torques can be adjusted in combination
- Characteristics of a Kaplan turbine1
- Adjustable guide vanes for setting the power output1

Water turbines are turbo-machines utilizing water power. They convert pressure and flow energy into mechanical energy and mostly are used for driving electrical generators. Water turbines can be divided into impulse and reaction turbines depending on their operating principle.

Tesca Multi-Turbine: Pelton, Francis & Kaplan Turbines and Accessories contain a Pelton turbine as an example for an impulse turbine and a Francis turbine as an example for a reaction turbine. The two turbine types are examined and compared with each other together with the Turbine Supply Unit and the Universal Drive and Brake Unit. The drive unit offers the possibility to set constant speeds resp. torques. Thus you can realize experiments in different realistic operating modes.

The Pelton turbine is a free-jet turbine that converts the pressure energy of the water into kinetic energy entirely in the control device. As the complete pressure difference is reduced exclusively in the nozzle, the pressure is constant in the impeller. The turbine is also known as a constant pressure turbine. The turbine power is controlled by adjusting the nozzle cross-section.

The Francis turbine converts the pressure energy of the water into kinetic energy in the control device and in the impeller. The pressure at the wheel inlet is higher than at the wheel outlet. The turbine power is controlled by adjusting the vanes in the control device.

The Turbine Supply unit provides the water supply, the pressure measurement at the turbine inlet, and the flow rate measurement. In order to measure the pressure at the turbine outlet, the Francis turbine is equipped with an additional pressure sensor. Tesca Universal Brake and Drive Unit measures the braking torque and the speed.

The well-structured instructional material sets out the fundamentals and provides a step-by-step guide through the experiments.

The Kaplan turbine is a reaction turbine with an axial through the flow. It has a high specific speed and is suitable for large water flows and small to medium heads. Therefore, the Kaplan turbine is used as a "classic" water turbine in run-of-the-river power stations.

Kaplan turbine helps to investigate the characteristic behavior of a simple-regulated Kaplan turbine during operation. The trainer is provided with a closed water circuit with a tank, submersible pump, and throttle valve for adjusting the flow rate. The angle of attack and thus the power output of the impeller is changed by adjusting the guide vanes. The turbine is loaded with a wear-free eddy current brake. The speed is captured by means of an inductive, non-contact position sensor at the turbine shaft. For determining the turbine power, the eddy current brake is equipped with a force sensor for torque measurement. The pressures at the inlet and outlet of the turbine, the temperature, and the flow rate are recorded with sensors. The recorded measured values are displayed digitally and processed further on a PC. The PC is used to calculate the power output data of the examined turbine and to 0represent them in characteristic curves.

Specifications:

- Comparison of a Pelton turbine as impulse turbine and a Francis turbine as reaction turbine accessories for the Turbine Supply Unit
- Operation by use of the Universal Brake and Drive Unit
- Constant torques and speeds can be adjusted with Universal Drive and Brake unit
- Transparent front panel in the turbines for

Note: Specifications are subject to change.

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observing the operating area
- Adjustable nozzle needle for setting different nozzle cross-sections (Pelton turbine)
- Adjustable guide vanes for setting different angles of incidence (Francis turbine)
- A pressure sensor at the Francis turbine for measuring the pressure at the turbine outlet
- Digital display for flow rate, pressures, and temperature in Turbine Supply Unit
- Braking torque and speed measured in function of a Kaplan turbine
- Closed water circuit with a submersible pump, throttle valve, and tank adjustment of flow rate with a throttle valve
- Loading the turbine by use of air-cooled eddy current brake impeller with fixed vanes
- Adjustable guide vanes for setting different angles of attack
- Non-contact speed measurement at the turbine shaft and force sensor at the brake for measuring the torque
- Digital display for pressures, temperature, flow rate, speed, and torque

Technical Specifications:

Translation ratio between brake and turbine: 1,44:1 Pelton turbine
- Output: 1,5kW at 2750min-1 at 6,5bar
- Wheel diameter: 165mm
- Variable nozzle setting

Francis turbine
- Output: 1kW at 3500min-1 and 4,2bar
- Wheel diameter: 80mm
- Variable guide vane setting

Kaplan turbine
- Max. output: 1000W
- Max. speed: 3700min-1
- Control wheel

8 guide vanes, adjustable: -15°...45°
external diameter: 120mm, internal diameter: 60mm
- Impeller, 4 vanes, fixed

external diameter: 120mm, internal diameter: 60mm, pitch: 80mm
Submersible pump with motor
- Max. flow rate: 250m³/h
- Max. pump head: 11m
- Nominal power: 3,1kW

Tank: approx. 350L
Measuring ranges
- Temperature: 0...100°C
- Pressure (at turbine inlet): 0...1bar rel.
- Pressure (at turbine outlet): -1...0,6bar rel.
- Flow rate: 13...200m³/h
- Torque: 0...10Nm
- Speed: 0...6500min-1

Stroboscope
- Covers the range of 250 - 18000 flashes per minute with an accuracy of ±2%.
- Light source is an easily replaceable Xenon Flash Tube.

Optional:

Data Acquisition System
- A PC with a Pentium processor
- An electronic signal conditioning system
- A stand-alone data acquisition modules
- A Windows-based software

Computer-Aided Learning
- Multimedia features
- Interactive
- Graphic simulation
- Experiment results samples
- Full experiment manuals

Supervisory Control & Data Acquisition - Data Logging
- Signal Analysis
- Process Control
- Real-Time Display
- Tabulated Results
- Graph of Experimental Results

Experiment Possibilities

- Determination of mechanical output
- Determination of efficiency
- Recording of characteristic curves
- Investigation of the influence of the nozzle cross-section on the power output
- Determination of power output curves at different speeds
  - Hydraulic power output
  - Mechanical power output
- Determination of the head
- Determination of turbine efficiency
- Investigation of the influence of the vane position on power output and efficiency

Services Required:

- Mains power supply: 220-240V, 1Ph, 50Hz

Note: Specifications are subject to change.

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