FRANCIS, PELTON AND KAPLAN TURBINES BENCH

Mod. TUR-PFKE/EV

INTRODUCTION

The Bench mod. TUR-PFKE/EV is an educational unit for the study of the technical characteristics of the three most common hydraulic turbines for the hydroelectric generation: Pelton, Francis, Kaplan.
The measurements, which can be performed varying the operation conditions, can be easily compared with data resulting from the theory.

TRAINING PROGRAM

- Study of the cavitation of a centrifugal pump
- Determining the characteristic curves (head/flow rate) of a centrifugal pump
- Determining the NPSH of a centrifugal pump
- Determining the efficiency characteristics of a centrifugal pump
- Determining the characteristic torque curves at the axis of a centrifugal pump
- Determining the absorbed power characteristics of a centrifugal pump
- Study of the operation of hydraulic turbines
- Plotting of the characteristic diagram of hydraulic power as a function of the rotation speed and the opening of the distributor (Pelton, Kaplan, Francis turbine)
- Plotting of the characteristic diagram of generated power as a function of the rotation speed and the opening of the distributor (Pelton, Kaplan, Francis turbine)
- Plotting of the characteristic diagram of torque to the axis as a function of the rotation speed and opening of the distributor (Pelton, Kaplan, Francis turbine)
- Plotting of the characteristic diagram of efficiency as a function of the rotation speed and opening of the distributor (Pelton, Kaplan, Francis turbine)

TECHNICAL SPECIFICATIONS

Hydraulic section: a centrifugal pump sends the flow to the turbine under test, simulating the waterfall. The pump motor is velocity-controlled for vary the flow conditions. The turbine under test is selected by a set of valves. By measuring the water flow and pressure, it is possible to calculate the hydraulic power (Ph) supplied to the test turbine.

Mechanical section: the turbine under test is coupled to a permanent magnets DC generator simulating a variable brake. There is only one DC generator, which is moved and coupled to the turbine under test. The electrical power is dissipated in a resistive load. By measuring the generator electrical parameters (V, I, rpm) it is possible to calculate and plot the electrical power (Pe). The Efficiency % is then calculated with Ph and Pe.

The unit includes:

- Stainless steel tank, capacity 500 l approx
- Wheeled frame
- Direct reading flow meter, 15000 l/h max
- N°2 pressure gauges 0 to 6 bar: pump outlet, turbines inlet
- Vacuum meter (pump inlet)
- Oscillating frame d.c. electric motor to operate the centrifugal pump: 4.5 kW at 3000 rpm
- Torque transducer (for DC motor)
- Speed sensor (for DC motor)

- Centrifugal pump:
  - revolution speed: 2900 rpm
  - power: 4 kW
  - flow rate: 110 to 315 l/min
  - head: 57 to 46 m H_2O
- Francis turbine made of corrosion proof material with guide rotary blades and back shield made of transparent plexiglas.
- Pelton turbine made of corrosion proof material with outflow nozzle of Doble type made of stainless steel, deviation plate and glow screen made of transparent plexiglas
- Kaplan turbine made of corrosion proof material with back shield made of transparent plexiglas
- Turbine braking unit with permanent magnet DC servomotor:
  - rated current 5,4 A
  - rated voltage 48 V
  - max power 210 W @ 3000 rpm
- Speed sensor (DC servomotor)

Power supply: 230 Vac 50 Hz single-phase - 1,3 kVA
(Other voltage and frequency on request)

Dimensions: 1400 x 700 x 1000 (h) mm (main unit)
600 x 400 x 400 (h) mm (control unit)

Tot weight: about 115 kg

REQUIRED

UTILITIES (PROVIDED BY THE CUSTOMER)

- Tap water: a sufficient quantity to fill the tank

SUPPLIED WITH

THEORETICAL - EXPERIMENTAL HANDBOOK

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