Hydraulic Turning Gear
For the Start-up, Interval and Cool-down Turning of a Turbine Rotor

Technical Information

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Robust, proven and reliable –
Hydraulic Turning Gears for Gas and Steam Turbines

Introduction

When a turning gear is integrated into a gas or steam turbine, three tasks are assigned to this module:

▶ To produce the initial conditions for the starting of the turbine allowing a high complication-free run-up of the rotor. That means overcoming the breakaway torque of the turbine shaft in order to minimize the imbalance and/or friction by means of slow rotation of the turbine rotor and creating the speed-dependent starting conditions for the electronic control
▶ To carry out an even further rotation after stopping the turbine in order to prevent thermal distortion
▶ To turn the rotor when unused for long periods at regular intervals to prevent static deformations and to control the mechanical ease of rotation

System Structure

Hydraulic turning gears are generally designed with or without a gear box arranged between hydraulic motor and turbine shaft. In the case of the version with a gear box, the hydraulic turning gear consists of the main components, hydraulic motor, control block and engagement cylinder. If the gear box is not installed, a low-speed hydraulic motor (see picture) is used. This, in turn, is coupled with the turbine shaft via an overrunning clutch, for example.

Depending on turbine size, it is possible to create the turning gear in terms of the mechanical hydraulic motor parameters, torque and speed, as well as the cylinder function values, actuation force and speed, via the selection of components and the definition of system pressure and flow.

Features

▶ Use of hydraulic radial or axial piston motors
▶ Engagement cylinder in mill-type design
▶ Hydraulic control functions integrated in a control block
▶ System design adapted to turbine size and oil supply
▶ Complete use of standard components

Benefits

▶ Robust design
▶ Clear arrangement of the control block components
▶ Easy control
▶ Proven system solution from a single source
▶ Low maintenance

Slow-speed hydraulic radial piston motor - suitable for gearless direct drive of the turbine rotor.
Function

The function of a hydraulic gear is explained by a model with a gear box:
During normal operation of the turbine, the engagement cylinder ring chamber is relieved of pressure.
The intermediate pinion arranged on the swivel arm is held out of operation by spring force. A continuous reduction in the rotary speed of the turbine rotor occurs after shutdown of the turbine. After reaching "operation speed" recorded in the turbine control the rotary speed of the hydraulic motor is adjusted by the proportional throttle valve so that a synchronized coupling of intermediate pinion gear and turbine can be effected. Thus, the phase of the cool-down turning is initiated, which takes place in a speed range from 5 to 150 rpm. The intermediate pinion connected with the hydraulic motor has to adjust in engage position with the stationary position of the rotor gear ring both in start-up and interval turning modes.
To avoid standstill damage, the hydraulic motor is operated at idle at low speed (about 10 to 20 rpm).

Application Example

A hydraulic turning gear must be applied for start-up, cool-down and interval turning of the rotor of an industrial gas turbine with a gear box for the speed range from 5 to 150 rpm.
The continuous rotation of the turbine rotor requires a torque of 1300 Nm, as a starting torque of 2000 Nm is required. The gear box of the attached turning gear has a gear ratio of 1:5.
The hydraulic cylinder of the pinion pivot device should be capable of an operating force of max. 1 kN applied evenly over a stroke of 50 mm.
The time of the engaging operation must be manually adjustable in the range of 0.5 to 1.0 s. The available pressure oil supply is designed for a maximum pressure of 210 bar and is limited to a volumetric flow rate of 100 l/min.
**Question:** Which hydraulic components would be suitable for assembling of a hydraulic turning gear?

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
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<tbody>
<tr>
<td><strong>Hydraulic motor</strong></td>
<td>Taking account of the predetermined gear ratio, the hydraulic motor to be capable of a torque constant of &gt; 1.90 Nm/bar for a speed range of 25 to 700 rpm. A2FM125/ to RE 91001</td>
</tr>
<tr>
<td><strong>Proportional throttle valve</strong></td>
<td>To drive the hydraulic motor, a direct operated proportional directional valve with dual flow is used in this application example. 4WREE10 to RE 29061</td>
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<td><strong>Shut-off valve</strong></td>
<td>Serving as a solenoid-operated shut-off valve is a direct operated directional spool valve with double flow. 4WE 10 to RE 23327</td>
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<td><strong>Engagement cylinder</strong></td>
<td>The cylinder design takes into account that the available maximum pressure is sufficient to apply the actuating force of 1 kN. The required flow rate is obtained from the minimum manipulating time. CDM1/25/18 to RE 17328</td>
</tr>
<tr>
<td><strong>Directional poppet valve</strong></td>
<td>Two series connected poppet valves ensure that the hydraulic cylinder can be depressurized even when a valve is defective. M-3SEW6 to RE 22058</td>
</tr>
<tr>
<td><strong>Throttle valve</strong></td>
<td>The selected throttle valve for adjusting the volume flow rate to the cylinder is manually adjustable so that the operating time of the hydraulic cylinder can be adjusted infinitely. F5P3 to RE 27761</td>
</tr>
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</table>

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