PUMP Brief

Hydraulic Pump Division

AS-0017

Gold Cup Solution Series: Part 3

Turbine Starter Systems

The need for electrical power in many countries today is growing faster than it is possible to build conventional or nuclear power plants. Hence, smaller or mobile generating systems are used with turbines driving a generator to develop the needed power. These systems can be land based in remote or developing areas. Or, offshore where conventional power sources are not available.

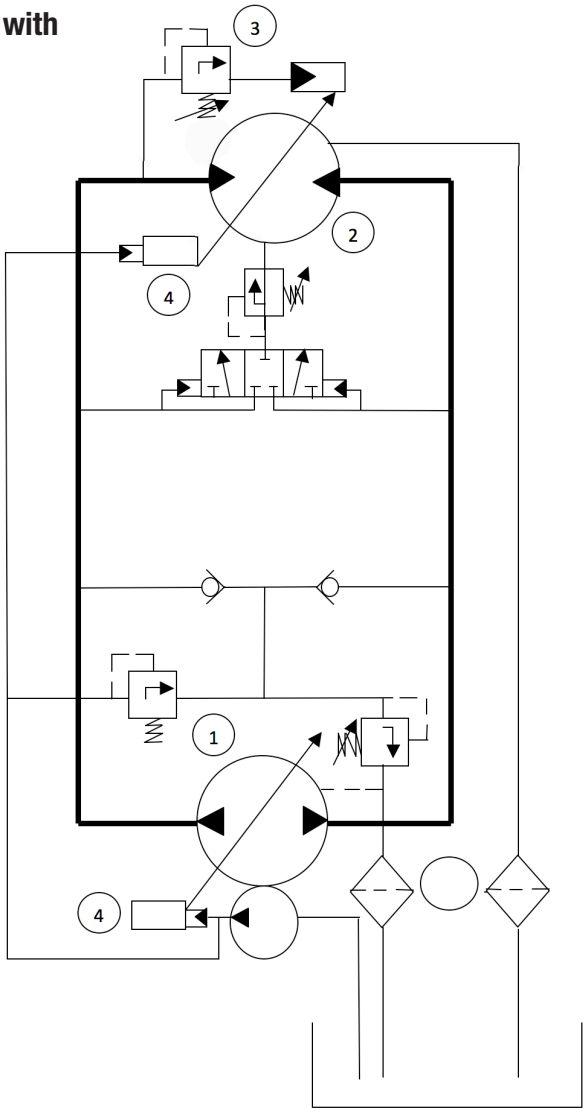
Starting a turbine requires a system that can turn the turbine's large mass up to a constant speed, and hold it for a specified time before the fuel can be injected, ignited and the starter system uncoupled, usually through an overrunning clutch.

Depending on the power available at the location, these starter systems can be electric motor or diesel engine driven utilizing hydraulic closed circuit systems. These can be in various formats using a combination of fixed or variable displacement pumps and motors depending on the requirements, specifications or preferences of the manufacturer or end user.

Smaller systems have previously used fixed displacement motors with a variable displacement pump – which has limitations. On larger systems a variable displacement motor is used with a variable displacement pump.

Turbine Starter Circuit with Reverse Compensator

1) Pump
2) Motor with Shuttle
3) Reverse Compensator
4) Servo Control



IMG-0020

There are two variable displacement options to consider:

1. Variable displacement pump with variable displacement motor – using *a reverse compensator.*
2. Variable displacement pump with variable displacement motor – both *having servo controls.*

The turbine's large mass requires a high torque at the motor to begin rotation. However, as the turbine increases speed, the torque requirement reduces as it moves towards its ignition speed.

Option 1: Variable displacement pump with variable displacement motor – *using a reverse compensator* (*see IMG-0020*).

In considering this option you may be confused by the term "reverse compensator".

Parker Gold Cup closed circuit transmission pumps are fitted with a pressure compensator override (PCO), which comes into operation when the maximum system pressure is reached. At this point the PCO overrides the servo signal (command signal) and returns to as close to zero stroke as the leakages in the system dictate while maintaining the pressure setting.

A reverse compensator, which is fitted to the motor, does the opposite. When it reaches the maximum pressure setting, it drives the motor to full stroke where the maximum torque can be achieved.

The following is a typical starting sequence:

The pump is started and brought up to its running speed in a neutral condition until all stand by pressures and temperatures have been reached. The

This turbine starter system utilizes a Gold Cup P11P pump with a T6 vane pump mounted to the rear to drive a bent axis motor.

motor is held at minimum displacement by the control (usually a 2A2 on a Gold Cup motor). When the turbine is ready for starting, the pump is commanded to full stroke. However, due to the large mass of the turbine, the pressure rises quickly exceeding the setting of the reverse compensator and driving the motor to full displacement with maximum torque capability.

As the turbine picks up speed, the pump continues to increase its stroke maintaining enough flow to maintain the pressure setting at the motor until maximum displacement is reached.

When the pump reaches full displacement, the pressure will start to drop and the motor will start to reduce displacement and continue doing so until the minimum displacement setting has been reached and the turbine is at ignition speed. On turbine ignition, and as the speed begins to increase, the motor is uncoupled through the overrunning clutch and the hydraulic power unit is shut down.

Option 2: Variable displacement pump with variable displacement motor – *both having servo controls.*

This option works the same as Option 1. But, instead of a reverse compensator, the motor is fitted with a servo control. The starting sequence is the same, but the motor is now commanded to full displacement before the pump is put on stroke. When the pump reaches full displacement, the motor is then commanded to reduce stroke to the minimum displacement setting until the turbine is up to ignition speed.

Summed Up

The advantage to using Option 2 is that if the turbine has to be maintained at a fixed speed for a time before ignition takes place, then the motor can be controlled to maintain this speed regardless of temperature, friction, etc. This approach lends itself to PLC control where all the control features can be monitored and adjusted to provide maximum optimization and increased safety.

With this option, the starting time is very fast and repeatable. Plus, a single power unit can start multiple turbines.

In offshore oil and gas and similar applications, the same systems can be utilized with explosion proof controls to meet the most demanding requirements. Parker Gold Cup products are certified to ATEX standards and can be supplied with the relevant nameplates and certification. This is in addition to the marine certifications Parker has experience with for many years such as Lloyds, DNV, ABS, etc.

Support

Have a closed circuit or turbine starting question? Call the Technical Support Team at **937.644.3915**, or contact **pumptechsupport@parker.com** for assistance.

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