Figure 14-4. *Powerplant instrumentation—fixed shaft turboprop engine.*

Torque developed by the turbine section is measured by a torque sensor. The torque is then reflected on the instrument panel horsepower gauge calibrated in horsepower times 100. ITT is a measurement of the combustion gas temperature between the first and second stages of the turbine section. The gauge is calibrated in degrees Celsius (°C). Propeller rpm is reflected on a tachometer as a percentage of maximum rpm. Normally, a vernier indicator on the gauge dial indicates rpm in 1 percent graduations as well. The fuel flow indicator indicates fuel flow rate in pounds per hour.

Propeller feathering in a fixed shaft constant-speed turboprop engine is normally accomplished with the condition lever. An engine failure in this type engine, however, results in a serious drag condition due to the large power requirements of the compressor being absorbed by the propeller. This could create a serious airplane control problem in twin-engine airplanes unless the failure is recognized immediately and the affected propeller feathered. For this reason, the fixed shaft turboprop engine is equipped with negative torque sensing (NTS).

NTS is a condition wherein propeller torque drives the engine, and the propeller is automatically driven to high pitch to reduce drag. The function of the negative torque sensing system is to limit the torque the engine can extract from the propeller during windmilling and thereby prevent large drag forces on the airplane. The NTS system causes a movement of the propeller blades automatically toward their feathered position should the engine suddenly lose power while in flight. The NTS system is an emergency backup system in the event of sudden engine failure. It is not a substitution for the feathering device controlled by the condition lever.

Split Shaft/ Free Turbine Engine

In a free power-turbine engine, such as the Pratt & Whitney PT-6 engine, the propeller is driven by a separate turbine through reduction gearing. The propeller is not on the same shaft as the basic engine turbine and compressor. *[Figure 14-5]* Unlike the fixed shaft engine, in the split shaft engine the propeller can be feathered in flight or on the ground with the basic engine still running. The free power-turbine design allows the pilot to select a desired propeller governing rpm, regardless of basic engine rpm.

A typical free power-turbine engine has two independent counter-rotating turbines. One turbine drives the compressor, while the other drives the propeller through a reduction gearbox. The compressor in the basic engine consists of three axial flow compressor stages combined with a single centrifugal compressor stage. The axial and centrifugal stages are assembled on the same shaft and operate as a single unit.

Inlet air enters the engine via a circular plenum near the rear of the engine and flows forward through the successive compressor stages. The flow is directed outward by the