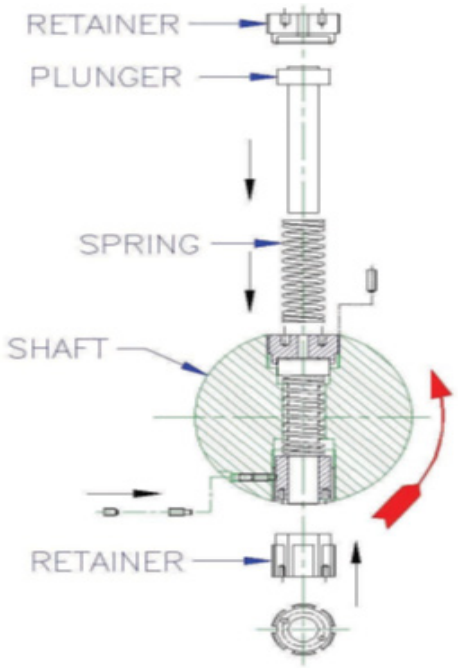
STEAM TURBINE OVER SPEED TRIP

By Sydney Gross

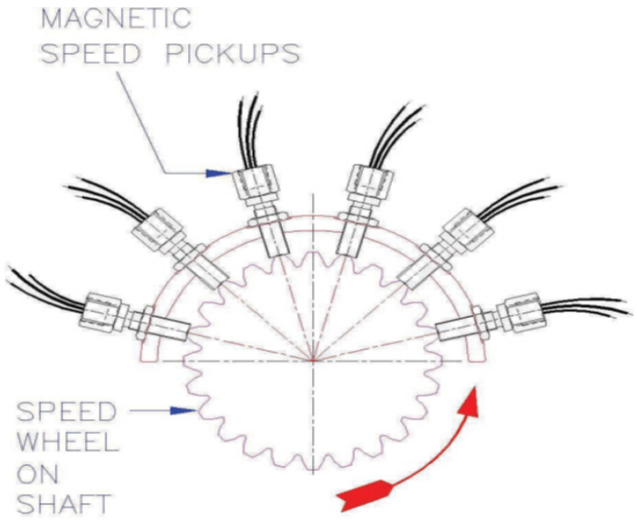
When we talk about over speed with respect to turbine rotors we refer to a limit in rpm beyond which the rotor is not guaranteed for continuous operation. This speed is the MCS, maximum continuous speed or MCOS, maximum continuous operating speed. Trip speed is a point which, if reached, the machinery protection system will commence shutting the turbine down.

API defines MCOS as 105% of the highest specified design speed of the turbine and the trip speed as 110% of MCOS. The idea is that the turbine should operate around rated speed but not beyond MCOS, hence the 5% margin. However, speed excursions do occur and are limited only by the governing system's ability to control them. Therefore there is a 10% speed margin above the MCOS which accommodates the governor system reaction.



MECHANICAL OVERSPEED MONITORING

Additionally, since there is a lag from the time the trip system senses trip speed and when the trip valve is shut and energy to the turbine is isolated, the rotor will achieve a higher speed than trip speed. Therefore, API requires that new rotors be designed for momentary operation up to 110% of trip speed.



ELECTRONIC OVERSPEED MONITORING

In order to achieve trip speed shut down, the trip system has to sense turbine speed and initiate trip valve closing. Trip valves are commonly shut with a heavy spring and are latched open mechanically by system oil pressure. Loss of oil pressure initiated by an oil dump valve then results in valve closing. In a mechanical system, the dump valve is activated directly by mechanical input from a shaft knockout plunger or other centrifugally displaced mechanism. When a high enough rpm is reached the mechanism displaces enough to strike a lever that activates the dump valve. The electronic system senses shaft speed through non-contacting magnetic pick-up sensors. The input goes to the electronic over speed control unit, which initiates the dump valve actuation.

Development of electronic trip systems over the past several years has established their reliability and speed such that they are preferred by most users and manufacturers. Many older turbines have been successfully retrofitted with electronic systems and the mechanical system is either kept as redundant or discarded. One of the primary benefits of the electronic system is that it can be set and tested without actually over-speeding the turbine which is inherently dangerous. This is accomplished by way of a signal generator providing the speed input to the control unit rather than the shaft.

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