CONTROL VALVE SETTING

By Scott MacFarlane

There are two main styles of valve lift arrangements for multi-valve steam turbine valve racks. They are the camshaft arrangement and the straight lift bar arrangement. See Figure 1 and Figure 2 respectively for a reference. The camshaft configuration utilizes cams, bearings, levers, and bushings which are connected to the camshaft to regulate the position of each valve. An actuator drives a rack and pinion connected to the camshaft to dictate the position desired by the governor. The lift bar configuration utilizes a bar internal to the steam chest, with all the valves plugs and stems attached. They are all lifted together by an actuator through various linkages. However, the length of each valve stem is set at different heights for the valves to open in a desired sequence. The control valves and sequencing of the valves are crucial during start up, shut down and normal operations.

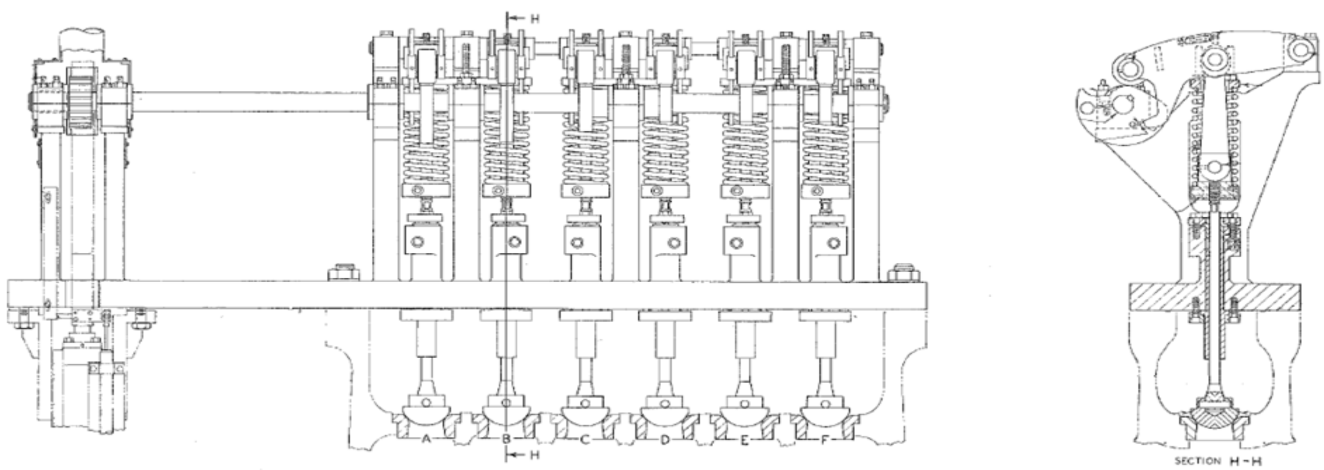

Figure 1

The main role of the control valves is to regulate the flow of steam into the turbine in a controlled and specific manner. For an individual valve, the lift height is linearly proportional to the amount of steam flow into the turbine over a limited range. After this range, a dead band will occur if no additional steam enters into the system through the other valves. When the governor hits a dead band and calls for more power, there is little or no response to change in valve lift resulting in hunting. To avoid these dead bands, sequential valve configurations allow overlap between each valve to maintain a near linear flow versus lift ratio. If the overlap between valves is too great, a small change in lift can result in large changes in turbine power. Both the dead band and excess overlap scenarios can result in the governor no longer being able to effectively control the turbine. The flow versus lift ratio is commonly referred to as the regulation or R-Line. An example of a typical five valve regulation line can be seen in Figure 3.

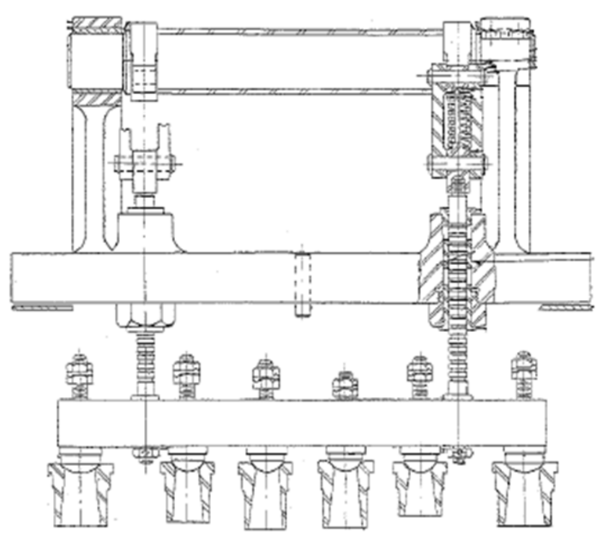

Figure 2

A good regulation line is established when the valve overlaps are set at the governing point of flow versus lift configuration. The pressure drop at the governing point varies by valve type and size but is typically between 7% and 13%. As an example, the pressure drop for a valve fully open is approximately 2%.

The valve is considered fully open when the surface area of the valve seat opening equals the surface area of the lift cylinder. See Figure 4 for a reference.

The approximate fully open lift height can be calculated based on the following equations.

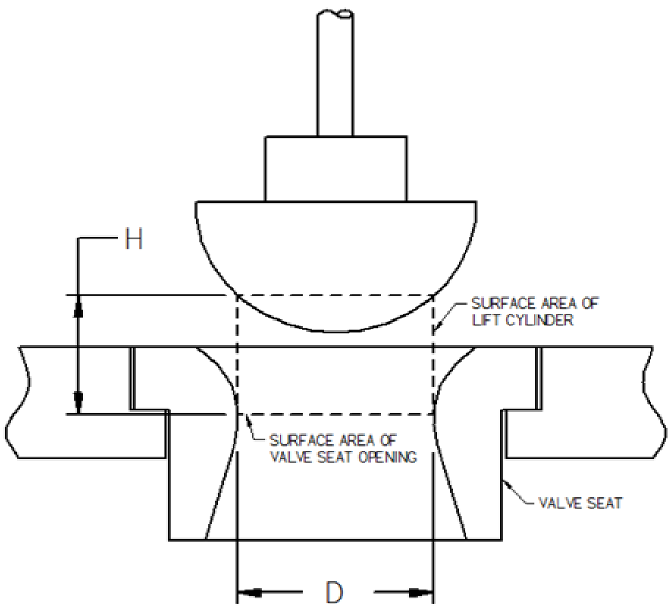

Figure 4

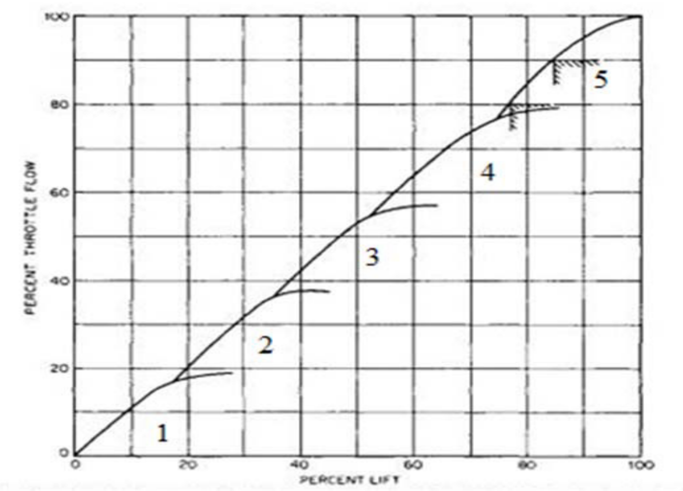

Figure 3

Surface Area Valve Seat Opening = $(\pi D^2) / 4$

D is the diameter of the valve seat opening.

Surface Area Lift Cylinder Exposed = πDH

D is the diameter of the valve seat opening.
H is the height the valve has lifted.

Setting the two equations equal to each other yields the following expression:

Approx. Full Open Valve Lift Height (H) = D/4

Understanding the sequencing and background of your valves can help prevent unstable operation. At each turnaround, the valve height settings should be checked and if necessary, reset to design conditions.

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