The Importance of Balancing Valves in HVAC Systems

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This is quite a controversial topic. In the last one decade, many articles have been published in various technical journals, many against the need of balancing valves with equal number, or may be more, rebuttals by manufacturers of balancing valves justifying the necessity. The intent of this article to understand the functioning and need of balancing valves keeping in mind the many developments in the field of electronic controls.

Starting from a simple globe valve, today, there are static (manual) balancing valves, dynamic (automatic) balancing valves, and the latest fad being dynamic balancing-cum-control valves.

Why are Balancing Valves Needed?

In a hydronic system pressure drops due to fluid friction across pipes and fittings. The pressure drop encountered by water up to each load may vary depending upon the distance from the pump and the number of fittings (*Figure 1*). The water flow rate through each load may vary as more water will tend to flow through the path of least resistance i.e., load nearest to the pump or with minimum piping friction loss. Balancing valves are used to compensate for variations in the piping pressure losses so as to ensure designed flow rate through each load. (*Figure 2*)

The variations in the piping losses could be compensated by using a reverse-return piping system (*Figure 3*) but the balancing valves may still be needed if the pressure drops across the load were asymmetrical.

This balancing ensures the designed proportion of the total pumped flow to each load and is, therefore, also termed as proportional balancing.

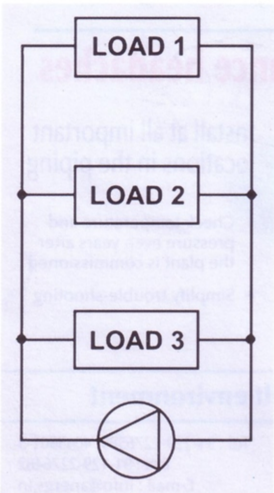

Figure 1: Direct piping system without balancing valves

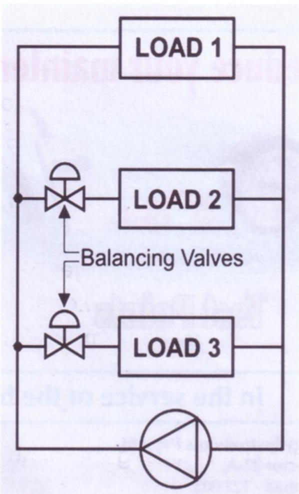

Figure 2: Direct piping system with balancing valves

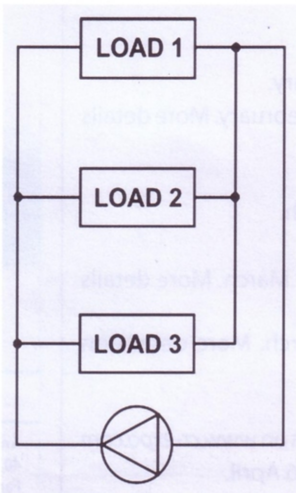

Figure 3: Reverse return piping system

Static Balancing Valves

These are basically similar to globe valves but with some defined flow vs pressure drop characteristics. The flow through each valve is calculated by measuring the pressure drop across the valve. The flow rate through the valve varies in direct proportion to the orifice-pass-area and system balancing is achieved by adding flow resistance, by reducing the orifice-pass-area, in circuits with lower pressure drops. It may sound very simple on paper but in a system with several connected loads, changing the setting of any one balancing valve affects the whole system and several iterations at each balancing valve may be necessary to achieve the desired results.

Dynamic Balancing Valves

Dynamic balancing valves were basically developed to keep the flow of water constant under varying pressure conditions for water supply applications to prevent the scalding of a user under a shower when another user flushed a toilet or opened a tap. In cold climates, where mixer taps are used for showering or bathing, a sudden drop in cold water pressure could reduce the cold water flow into the mixer and the resultant increase in the water temperature could be fatal.

These valves work on the principle that flow through an orifice varies according to the pressure across it, which may also be defined as that the flow through an orifice will remain constant if the size of the orifice is changed in proportion to the change in pressure drop across it.

Figure 4 shows a cartridge from this valve, in which the orifice has a variable opening and is spring loaded. Any change in pressure pushes or releases the spring to change orifice area, thus keeping the flow constant. The spring range is selected to match the pressure variations of the system. Normal system pressure should match the center of the spring range to ensure proper flow control, both in case of pressure increase or decrease. Outside the spring range, i.e., when it is either fully compressed or fully extended, the valve behaves as an ordinary valve, with no control over the flow.

This valve is an ideal solution in complex hydronic systems to eliminate the

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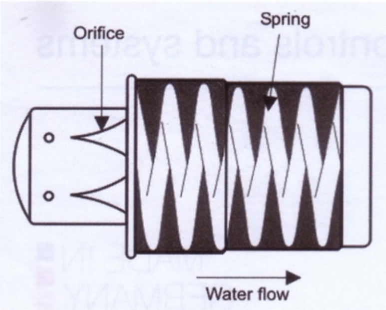

Figure 4: Dynamic balancing valve cartridge

need of time-consuming reiterative manual balancing, but has the following drawbacks:

- The need to keep the normal pressure drop at the center of spring range for proper functioning of the valve necessitates higher pumping pressures, thus higher energy usage.
- The water quality has to be strictly enforced/maintained, as any deposits or scaling can adversely affect the sliding movement of the orifice.

Summary

Balancing valves are basically designed to keep the flow in a circuit constant. Static balancing valves are set to achieve this with the assumption that the pressure variations in the whole system are unlikely to be much.

Automatic balancing valves maintain the constant flow even when there are pressure variations, within a certain range. These valves ensure better water distribution - but the difficulties start when used in conjunction with control valves, because control valves are also provided to vary the flow in a circuit to achieve designed parameters. More on that in the next issue.