STAEM VALVES AND STEAM TRAPS FOR THERMAL POWER STATION

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Abstract

There are different types of valve available for industrial application as per the requirement. valves are classified based on material use, based on application, based on function etc. No steam system is complete without that crucial component 'the steam trap' (or trap). This is the most important link in the condensate loop because it connects steam usage with condensate return. A steam trap quite literally 'purges' condensate, (as well as air and other incondensable gases), out of the system, allowing steam to reach its destination in as dry a state/condition as possible to perform its task efficiently and economically.

Keywords- steam traps, steam valves, drain header, condensate, air vent

I. INTRODUCTION

Types of valve

Butterfly Valves

Butterfly valves are typically utilized in large line sizes in chemical services, waste and water treatment applications and fire protection systems. Due to the valve design, incorporating a small face-to-face dimension and lower weight than most valve types, the butterfly valve is an economical choice for larger line sizes (i.e. 8" and above). Additional advantages of the butterfly valve are standard face to face dimensions, relatively high coefficient of flow (Cv) and their availability in chemically resistant materials. As with the ball valve, the butterfly valve complies with ASME face-to-face dimensions and pressure ratings. This enables the valve to be easily retrofitted in line regardless of the manufacturer. In addition, the small face-to-face dimension facilitates piping design. The ASME pressure classes adhered to by most manufacturers include 150, 300 and 600 allowing a maximum pressure of 1500 psi. The butterfly valve is considered a high recovery valve, since only the disc obstructs the valve flow path. The Cv is relatively high; the pressure drop across the valve is relatively low. Hence the pump size is minimized and system wear reduced compared to that of low recovery valves (i.e. globe valves).

Ball Valves

Ball valves are excellent in chemical applications, including the most challenging services (e.g., dry chlorine, hydrofluoric acid, oxygen). Readily available in a wide variety of configurations, 3- piece, end entry and top entry, these valves range from commodity type valves to high performance valves. Advantages of ball valves include ease of operation, standard face-to-face dimensions, high flow capacity, high pressure/temperature capabilities and ability to handle severe service chemicals. The quarter turn operation is desirable to most operators and fairly easy to automate. The face-to-face dimensions comply with ASME, making the ball valve easy to retrofit and replace in line with most other ball valves and plug valves. Also compliant with ASME is the flange rating, either 150, 300, 600, 900 # or occasionally higher classes, enabling high performance ball valves to withstand up to 2250 psi. The ball valve temperature which is primarily dependent on seats and seals may be rated as high as 550° F. Higher temperatures are permitted when using metal seats. Ball valves, available in reduced port and full port designs are considered high recovery valves, meaning a low pressure drop and relatively high C_v, [coefficient of flow (gpm per 1 psi pressure drop)]. The benefits of these desirable flow parameters are reduced pump size and less system wear due to lower velocity.

Applications

For chemical services, especially severe chemical services, ball valves are an excellent easy to operate choice. General sizes available are 1/2 – 12

Standard Port Ball Valve

Diaphragm Valves

Diaphragm Valves are typically utilized in applications where cleanliness, bubble-tight shut-off, and chemical compatibility are paramount. Available in two general designs, the weir style diaphragm valve is utilized for higher pressure applications. The straightway diaphragm valve, having no flow path obstructions, is well suited for higher flow and slurry applications. Due to the diaphragm valve's streamlined flow path, absence of cavities and minimal contact surfaces, the valve is considered the "cleanest" valve or the valve least likely to cause contamination. For this reason, the diaphragm valve is the workhorse of the pharmaceutical, bioprocessing and electronics industry in high-purity water systems. The diaphragm valve is also a frequent choice of the chemical processing industry, water treatment industry, power industry, mining industry and pulp and paper industries. A key advantage of the diaphragm valve is the wide variety of wetted materials providing an economical chemically compatible solution for almost any service. Typical body materials available are plastic lined, rubber lined, glass.

Straightway Type Diaphragm Valve

Globe Valves

The Globe Valve's complex flow path makes this configuration excellent for control. The valve operation is a linear rising-stem with multi-turn handwheel. The sealing device is a plug that offers limited shut-off capabilities, not always meeting bubble tight requirements. Depending on the specific construction and application, the globe valve may comply with ASME class II, III, IV, V or VI shut-off requirements.

Easily automated and available with positioners, limit switches and other accessories, the globe valve is known for precise throttling and control. Most control valve manufacturers either supply control valve sizing software programs or will size the valve for you. Control valve sizing is significantly more complex than on/off sizing, hence the software programs available can be of real benefit.

Globe Valve

Knife Gate Valves

Knife gate valves are used in three primary applications: non-abrasive slurry services such as in the pulp & paper industry, abrasive slurry applications as found in mining applications, and for large diameter water services as found in waste .water systems.

Special knife gate valves configurations are used for handling abrasive slurries. These range from hardened components to the use of polyurethane seats and liners to combat the abrasion. The most recent development for abrasive slurries is the double seated slide gate valve which uses two opposing elastomer seats that provide an elastomer conduit through the valve. This type does best in the most difficult high solids and scaling applications.

Knife Gate Valve

INTRODUCTION TO STEAM STRAP

The duty of a steam trap is to discharge condensate while not permitting the escape of live steam"The quantity of condensate a steam trap has to deal with may vary considerably. It may have to discharge condensate at steam temperature (i.e. as soon as it forms in the steam space) or it may be required to discharge below steam temperature, giving up some of its 'sensible heat' in the process.
The pressures at which steam traps can operate may be anywhere from vacuum to well over a hundred bar. To suit these varied conditions there are many different types, each having their own advantages and disadvantages. Experience shows that steam traps work most efficiently when their characteristics are matched to that of the application. It is imperative that the correct trap is selected to carry out a given function under given conditions. At first sight it may not seem obvious what these conditions are. They may involve variations in operating pressure, heat load or condensate pressure. Steam traps may be subjected to extremes of temperature or even water hammer. They may need to be resistant to corrosion or dirt. Whatever the conditions, correct steam trap selection is important to system efficiency.
It will become clear that one type of steam trap cannot possibly be the correct choice for all applications.

CLASSIFICATION OF STEAM TRAP

There are different criteria of steam trap classification, according the concept used to classify them. According to their operation principle, they can be classified in the following ways:

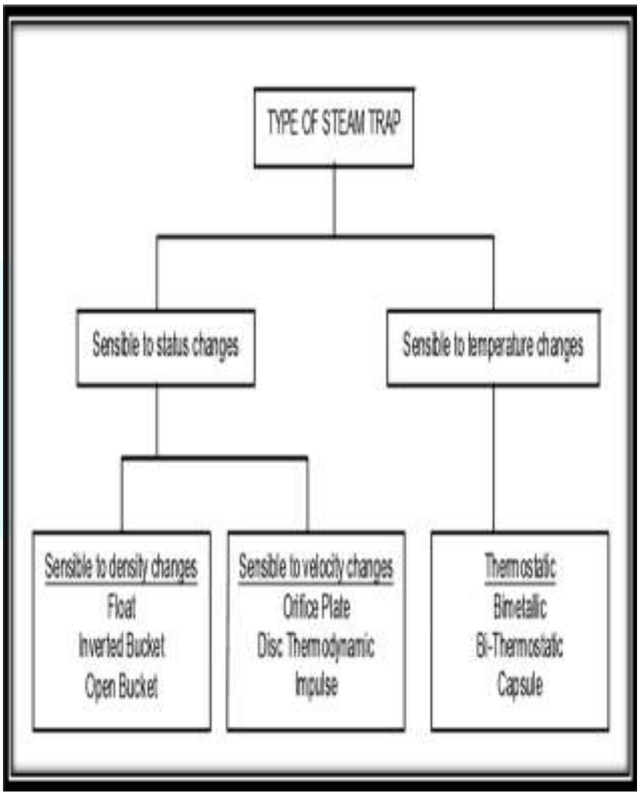

Table 5.4

GENERAL TYPES OF STEAM TRAP

There are three basic types of steam trap into which all variations fall; all three are classified by International Standard ISO 6704:1982.

Thermostatic (operated by changes in fluid temperature)

The temperature of saturated steam is determined by its pressure. In the steam space, steam gives up its enthalpy of evaporation (heat), producing condensate at steam temperature. As a result of any further heat loss, the temperature of the condensate will fall. A thermostatic trap will pass condensate when this lower temperature is sensed. As steam reaches the trap, the temperature increases and the trap close.

Mechanical (operated by changes in fluid density)

This range of steam traps operates by sensing the difference in density between steam and condensate. These steam traps include 'ball float traps' and 'inverted bucket traps'. In the 'ball float trap', the ball rises in the presence of condensate, opening a valve which passes the denser condensate. With the 'inverted bucket trap', the inverted bucket floats when steam reaches the trap and rises to shut the valve. Both are essentially 'mechanical' in their method of operation.

Thermodynamic (operated by changes in fluid dynamics)

Thermodynamic steam traps rely partly on the formation of flash steam from condensate. This group includes 'thermodynamic', 'disc', 'impulse' and 'labyrinth' steam traps.

MECHANICAL STEAM TRAP

Mechanical steam traps rely on the difference in density between steam and condensate in order to operate. They can continuously pass large volumes of condensate and are suitable for a wide range of process applications. Types include ball float and inverted bucket steam traps.

BALL FLOAT STEAM TRAP

The ball float type trap operates by sensing the difference in density between steam and condensate. In the case of the trap shown in Figure5.1, condensate reaching the trap will cause the ball float to rise, lifting the valve off its seat and releasing condensate. As can be seen, the valve is always flooded and neither steam nor air will pass through it, so early traps of this kind were vented using a manually operated cock at the top of the body. Modern traps use a thermostatic air vent, as shown in Figure 5.2. This allows the initial air to pass whilst the trap is also handling condensate.

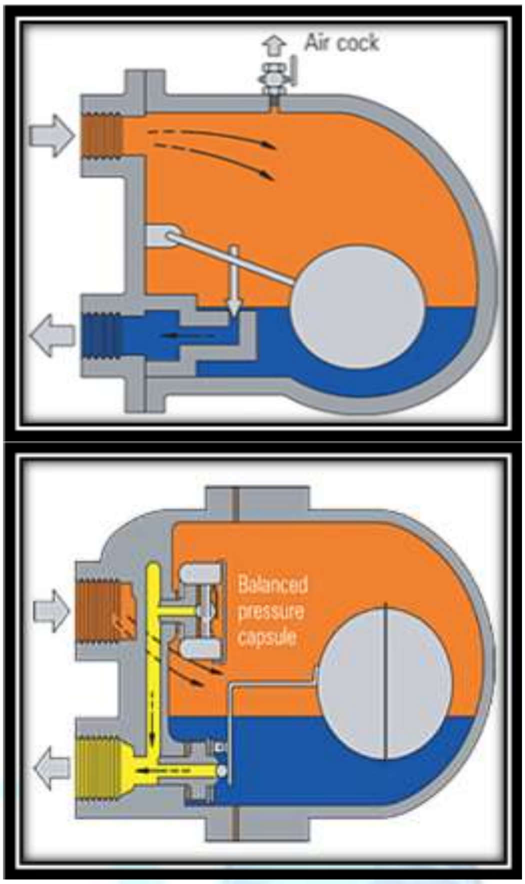

Figure 5.4 Float trap with air cock & Float trap with thermostatic

Air vent

The automatic air vent uses the same balanced pressure capsule element as a thermostatic steam trap, and is located in the steam space above the condensate level. After releasing the initial air, it remains closed until air or other non-condensable gases accumulate during normal running and cause it to open by reducing the temperature of the air/steam mixture. The thermostatic air vent offers the added benefit of significantly increasing condensate capacity on cold start-up.

II STEAM TRAP FOR DRAIN HEADER

STEAM TRAPS FOR DRAIN HEADER

SR NO.	DRAIN	TEMP (°C)	PRESSURE(ATA)	TYPES OF STEAM TRAPS
1	Control Valve Drain Steam System-1			
2	Control Valve Drain Steam System-1 2			
3	Wheel Chamber Drain System	446	48.24	THERMODYNAMIC STEAM TRAP
4	H.P. Heater Bleed-1	342.7	21.715	THERMODYNAMIC STEAM TRAP
5	H.P. Heater Bleed-2	342.7	21.715	THERMODYNAMIC STEAM TRAP
6	Extraction Line Drain-1	276.1	12.5	THERMODYNAMIC STEAM TRAP
7	Extraction Line Drain-2	276.1	12.5	THERMODYNAMIC STEAM TRAP
8	Balance Piston AK-1 Drain	419	5.095	THERMODYNAMIC STEAM TRAP
9	Balance Piston AK-2 Drain	419	5.095	THERMODYNAMIC STEAM TRAP
10	Turbine Casing Drain System	199	5.095	BALL FLOAT TYPE STEAM TRAP
11	Front Gland Sealing System	382.7	1.1	THERMODYNAMIC STEAM TRAP
12	Rear Gland Sealing System	250	1.1	BALL FLOAT TYPE STEAM TRAP
13	L.P. Heater Bleed Drain-1	104.8	1.223	BALL FLOAT TYPE STEAM TRAP
14	L.P. Heater Bleed Drain-2	104.8	1.223	BALL FLOAT TYPE STEAM TRAP
15	Desuperheating Drain System	250	1.1	BALL FLOAT TYPE STEAM TRAP
16	Inter Condenser Drain Ejector System			
17	After Condenser Drain Ejector System			
18	Normal Drain L.P. Heater			
19	Emergency Drain L.P. Heater			

III STEAM VALVES FOR DRAIN HEADER

VALVES FOR DRAIN HEADER

SR NO	DRAIN	TEMP (°C)	PRESSURE(ATA)	MATERIAL	CLASS	SIZE	TYPE OF VALVE	NO. OF VALVE
1	Control Valve Drain Steam System-1	515	85	CAS(WC9)	1500	NB25	Globe Valve	2
2	Control Valve Drain Steam System-1 2	515	85	CAS(WC9)	1500	NB25	Globe Valve	2
3	Wheel Chamber Drain System	446	48.24	CAS(WC9)	1500	NB25	Globe Valve	2
4	H.P. Heater Bleed-1	342.7	21.715	CCS(WCB)	300	NB25	Globe Valve	1
5	H.P. Heater Bleed-2	342.7	21.715	CCS(WCB)	300	NB25	Globe Valve	1
6	Extraction Line Drain-1	276.1	12.5	FCS(A105)	300	NB50	Globe Valve	1
7	Extraction Line Drain-2	276.1	12.5	FCS(A105)	300	NB50	Globe Valve	1
8	Balance Piston AK-1 Drain	419	5.095	CAS(WC9)	1500	NB25	Globe Valve	1
9	Balance Piston AK-2 Drain	419	5.095					
10	Turbine Casing Drain System	199	5.095	FCS(A105)	300	NB25	Globe Valve	1
11	Front Gland Sealing System	382.7	1.1	CCS(WCB)	300	NB25	Globe Valve	1
12	Rear Gland Sealing System	250	1.1	FCS(A105)	300	NB25	Globe Valve	1
13	L.P. Heater Bleed Drain-1	104.8	1.223	FCS(A105)	300	NB50	Globe Valve	1
14	L.P. Heater Bleed Drain-2	104.8	1.223	FCS(A105)	300	NB50	Globe Valve	1
15	Desuperheating Drain System	250	1.1	FCS(A105)	300	NB25	Globe Valve	1
16	Inter Condenser Drain Ejector System							
17	After Condenser Drain Ejector System							
18	Normal Drain L.P. Heater							
19	Emergency Drain L.P. Heater							

IV EXPECTED OUTCOMES

- By selecting proper steam valves we can save loss of steam in steam power plant.
- By using steam trap we can prevent loss of steam, thus we can save energy.
- We can do economical line sizing of thermal power plant.
- With help of this, we can recommend class of orifices, valves and steam straps with accordance to ANSI B31.1

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