Three Way Valve

For Control and On/Off Three - way Functions, Flow Mixing and Flow Diverting

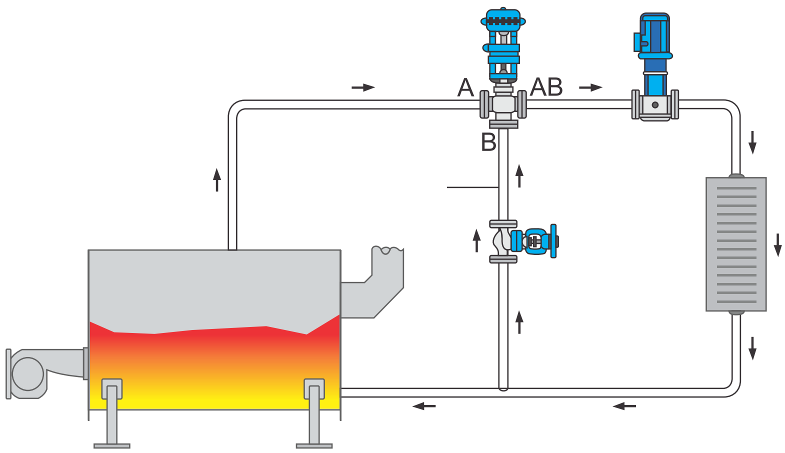
FORBES MARSHALL

Three Way Valve

A three way valve is a constant flow rate valve used for either mixing or diverting application. In these valves, the total flow rate remains constant. In applications where three way valves are employed, the liquid circuit will naturally split into two separate loops, constant and variable flow rate.

Three way valves are widely used in the industrial process applications to control the flow of different fluids, mainly for mixing two different fluids and diverting the excess fluid back to the source for efficient and accurate process control. This accurate and efficient process control is easily achievable using Forbes Marshall Arca three way control valves with construction to ensure minimal pressure losses across the valve, increasing overall process efficiency.

Mixing Valve (Constant Flowrate, Variable Temperature)



Typical Applications

All processes involving thermic fluids

Cooling system of motor ships

Heating and cooling systems for plate pressing, vulcanizing and other presses

Attemperator

pH and conductivity control

Application Standards

Design	ANSI B16.34
Flanges	ANSI B16.5
F/F Distance	ANSI B16.10
Leakage Class	ANSI B16.104 FCI70.2

Sizing Considerations

While selecting a three way valve, either for modulating or quick change duty, following are the important considerations.

Always size the valve to ensure minimum delta P across the ports. An undersized three way valve will create unnecessary differential pressure across the ports. It may result in increased pumping costs and small travel of stem will have larger impact on fluid directed through each port.

Oversizing the valve may reduce the pumping costs. However it will come at the expense of hysteresis. This could result in inaccurate control with large load changes.

Never size the valve with a consideration to create differential pressure across ports.

For any three way mixing valve, all the ports have to be in equilibrium (at same pressure). The thrust force produced due to flow through each port is countered by thrust force due to flow through another port. Hence only frictional forces and sealing forces need to be considered while sizing the actuator. The shut off pressure do not play any role in actuator selection.

For any three way diverting valve, please ascertain whether the same is used in closed loop system where all the three ports are in equilibrium or it is used for drain application where one port is open to atmosphere. The thrust force may be calculated accordingly for correct actuator selection.

In either case of mixing or diverting, always be sure about the ports identifier as below.

For mixing : Port A / Port B >> Port AB (A+B)

For diverting : Port AB >> Port A / Port B

Ensure to define the port condition (either open or close) for air fail condition for correct selection.

Series 200

This is the standard globe design three way valve with pneumatic or electric actuator with a lot of extension possibilities suitable for a wide range of applications. The basic equipment is fitted with a mixing or diverting plug and strong high capacity shaft guiding and serves at the same time as basis for multiple types of execution.

The present generation of the series 200 has been updated as a result of decades of development. Production on most modern CNC machining centres guarantees the highest precision and simple exchange of parts. The body design is optimised to flow conditions with large volumes.

Seats are not welded and can be unscrewed and serviced even after years of operation. Exchanging of seat and plug can be completed within few minutes. During maintenance, the valve remains in the pipeline. This saves cost during maintenance and installation. Capacity can easily be adapted to any modication, extension due to modular design.

Technical Information	
Body / bonnet	Carbon steel, alloy steel, stainless steel. Other materials such as Monel, Hastalloy, Alloy - 20, Aluminum, Bronze, etc. available on request
Plug	Stainless steel - AISI 410, 316, 304, 316L, 304L, 17-4PH, SS440C and others available on request
Seat	Stainless steel - AISI 410, 316, 304, 316L, 304L, 17-4PH, SS440C and others available on request
Spindle	Stainless steel - AISI 410, 316, 304, 316L, 304L, 17-4PH, SS440C and others available on request
Gland packing / gasket	Graphite (above 180 Deg C) for steam applications; PTFE for liquid applications
Leakage class	As per ANSI B16.104 / FCI 70.2
Standard finish	Leakage class IV, 0.01% of rated Kv
Ground finish	Leakage class V, 0.005% of rated Kv
Flow characteristics	Linear, customization available on request
Extended bonnet	Temperatures ³ 300º C
Standard bonnet	Temperatures < 300º C

Dimensions of Three Way Valve

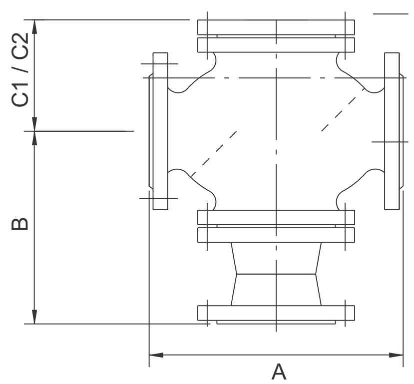


Fig. 2

Valve Description	A mm	A Inch	B mm	B Inch	C1 mm	C1 Inch	C2 mm	C2 Inch	Weight Kgs	Weight Lbs
25NB # 300	197	7.8	135	5.3	166	6.1	81	3.2	8	17.6
50NB # 300	267	10.5	196	7.7	225	8.9	121	4.8	42	92.5
80NB # 300	317	12.5	230	92	47	9.7	142	5.6	65	143.3
80NB # 600	356	14	256	10	263	10.4	199	7.8	80	176.3
100NB # 300	369	14.5	250	9.8	257	10.1	152	6.0	85	187.4
150NB # 300	473	18.6	370	14.6	339	13.3	213	8.4	150	330.7
200NB # 300	568	22.4	420	16.5	245	9.6	244	9.6	225	496
200 NB # 600	610	24.0	490	19.3	511	20.1	308	12.1	555	1223.5
250NB # 300	708	27.9	525	20.7	468	18.4	320	12.6	480	1058.2

C1-with finned bonnet
C2-with standard bonnet

List of Parts

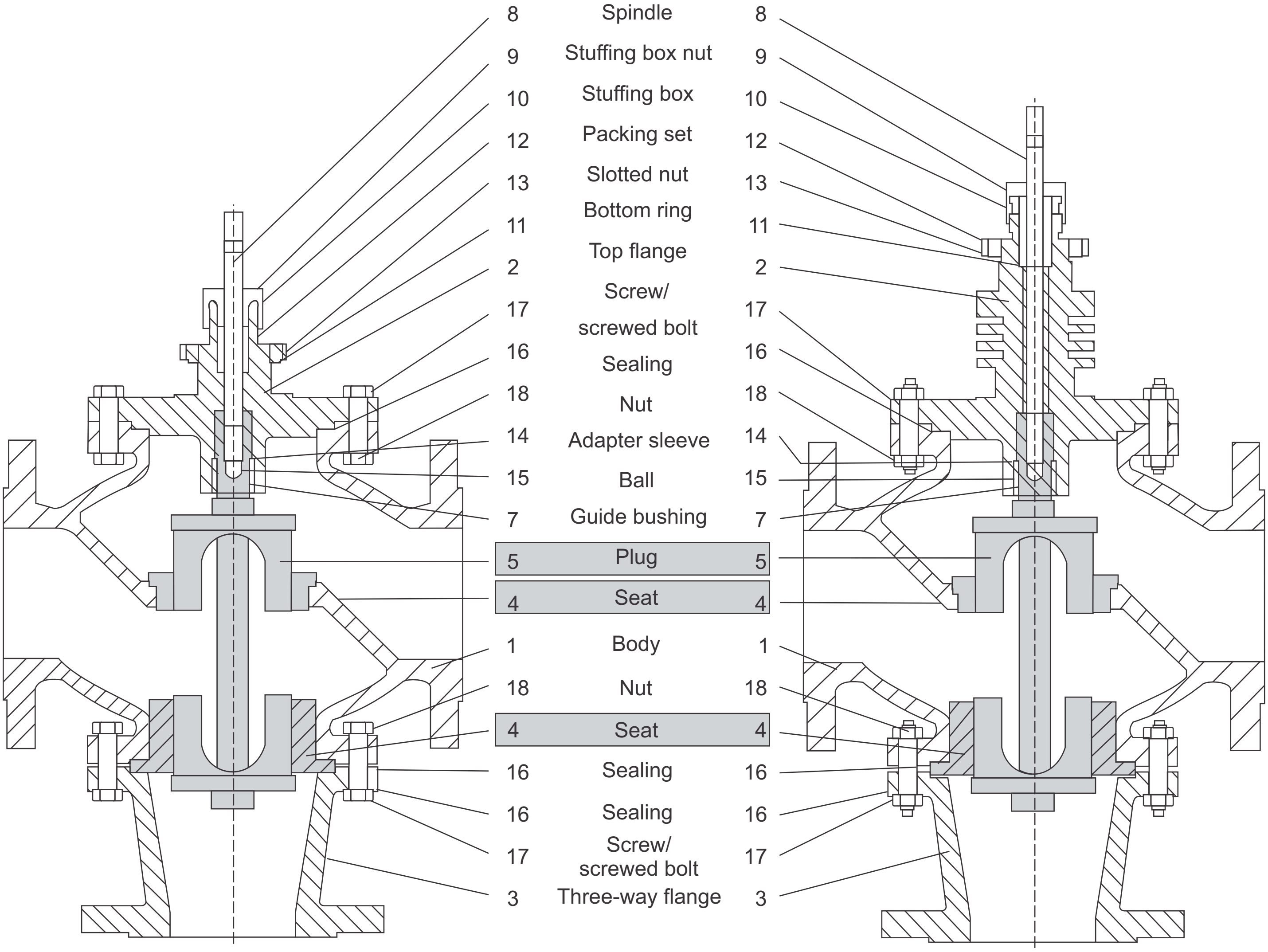


Fig. 1

Kv / Cv Values for Three Way Valve

Valve Size (mm / inch)													
25 / 1		50 / 2		80 / 3		100 / 4		150 / 6		200 / 8		250 / 10	
Kv	Cv	Kv	Cv	Kv	Cv	Kv	Cv	Kv	Cv	Kv	Cv	Kv	Cv
4	4.68	18	21.06	43	50.31	68	79.56	150	175.5	260	304.2	380	444.6
7	8.19	26	30.42	68	79.56	100	117	260	304.2	380	444.6	650	760.5
11	12.87	43	50.31	100	117	150	175.5	380	444.6	650	760.5	900	1053

Flow Diverting

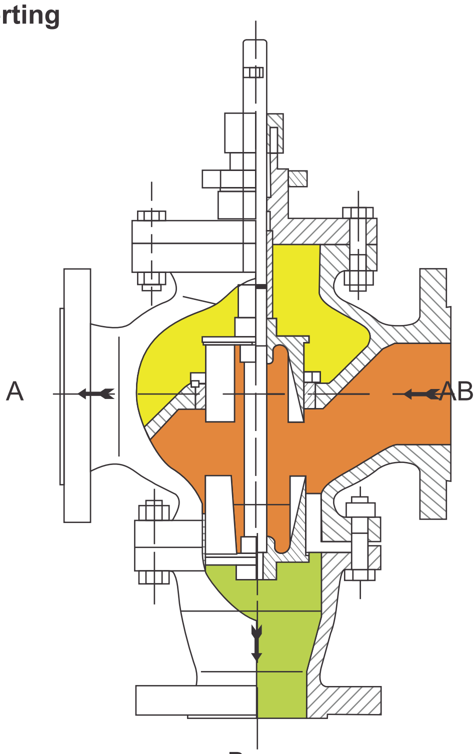


Fig. 3

The flow AB is divided into two exit flows A and B.

In both series the direction of the flow is always against the plug. The "bathtub" effect and the water-hammers caused thereby can be avoided. Standard diaphragm actuators can be used without special devices as for instance hydraulic brakes. The plugs are guided directly in the upper and lower seat, in the best way.

Flow Mixing

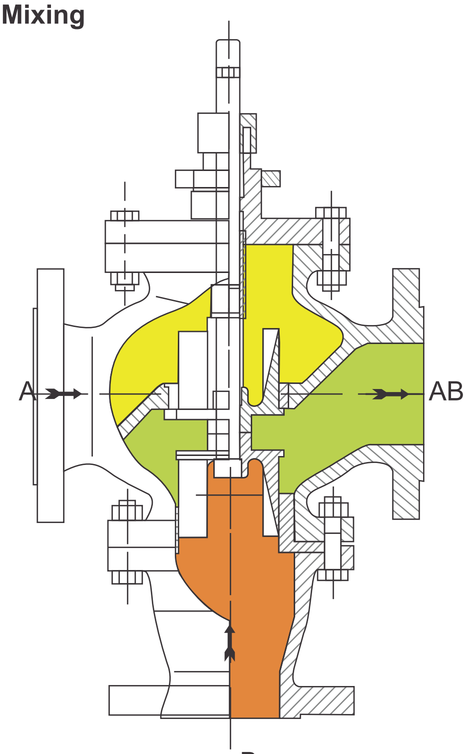


Fig. 4

The entrance flows A and B are mixed to a single exit flow AB. Typical application: temperature control.

Both types, mixing and dividing, are built from the same parts of the modular parts system. the bodies are chosen from the standard straight-through valve bodies, which grants a quick delivery. The plugs for mixing and dividing are identical. With some additional parts (spindle, distance bushing) you can convert one type into the other. The seats remain unchanged.and lower seat, in the best way.

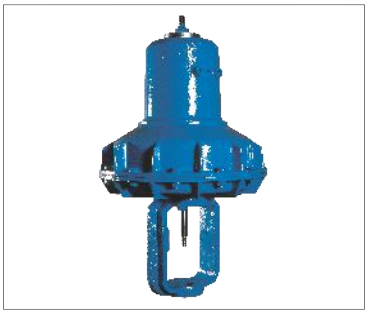
Three Way Valve with Electric Atuator

Three Way Valve with Bellow Sealed Bonnet

Universal Diaphragm Actuator - Series UI, UIII and UV

High actuating power at affordable cost

Forbes Marshall universal diaphragm actuator series UI, UIII and UV features a pneumatic actuator designed for applications that demand high actuating power. Its optional reinforced spring with compact air chamber delivers up to 14000 lbf thrust force for extreme pressure control applications. These diaphragm actuators can be fitted with standard accessories like positioner, feed-back transmitter, limit switches and air-filter regulator. Optional hand wheel is provided for emergency operations.



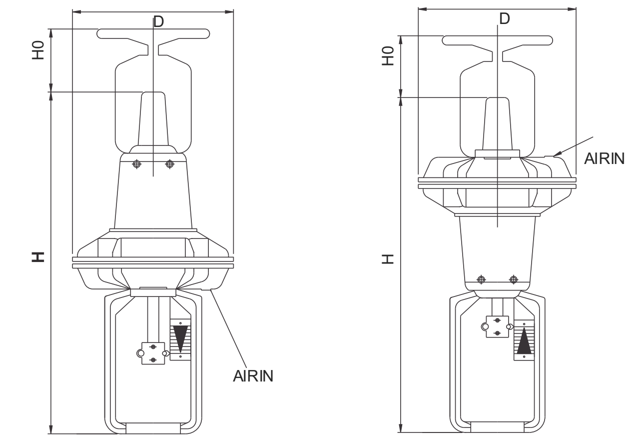
Actuator Technical Information

Temperature range	-13ºC to 90ºC
Maximum operating pressure	6 bar (g)
Linearity	< 2%
Hysterisis	Max. 3%
Air supply connection	¼" NPT*

*Others available on request

Materials

Diaphragm housing	Diecast Aluminium
Diaphragm	Purbunan Rubber
Springs	Stainless Chrome Steel
Spindle	Stainless Chrome Steel
Yoke	S G Iron



AIR TO OPEN
H - Without Hand wheel

Fig. 5

AIR TO CLOSE
H + HO - With Hand wheel

	H+HO	H	D
UI-20	630	495	270
UI-30	640	505	270
UIII-30	920	723	392
UIII-60	950	753	392
UV-60	1290	995	530
UV-100	1300	1005	530
UV-120	1315	1020	530

Features :

Field reversible - flexible control action
High thrust forces - usable in extreme pressure reductions
Low maintenance - less inventory
Cast aluminum housing - light weight and corrosion resistance

Thrust force (Kgs) - Air to Close

Air Supply Range Bar	Standard UI-20 UI-30 0.2-1.0 Bar	Standard UIII-30 UIII-60 0.2-1.0 Bar	Standard UV-60 UV-100 UV-120 0.2-1.0 Bar
2.8	560	1270	2540
3.0	620	1410	2820
3.5	776	1760	3525
4.0	930	2115	4230
4.5	1085	2470	4935
5.0	1240	2820	5640
5.5	1395	3170	6345
6.0	1550	3525	7050

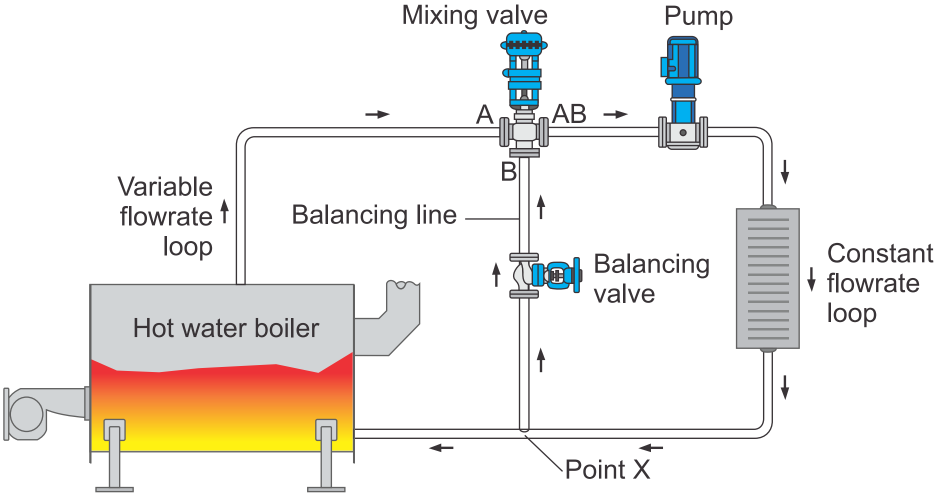
Thrust force (Kgs) - Air to Open

Actuator Model	Spring Range (Bar g)		Diaphragm Area (sq. cm)	Air to Open Spring to Close Thrust Force (Kgs)	Weight With Handwheel		Weight Without Handwheel	
	From	To			Kgs	Lbs	Kgs	Lbs
UI-20.n	0.2	1		60				
UI-20.n	0.4	1.2		125				
UI-20.n	0.6	1.4		185				
UI-20.n	0.8	1.6		250				
UI-20.n	1	1.8		310				
UI-20.v	1.2	2.25		370				
UI-20.v	1.4	2.45		435				
UI-20.v	1.6	2.65	320	500	19	42	16.8	37
UI-20.v	1.8	2.25		560				
UI-30.n	0.2	1		60				
UI-30.n	0.4	1.2		125				
UI-30.n	0.6	1.4		185				
UI-30.n	0.8	1.6		250				
UI-30.n	1	1.8		310				
UI-30.v	1.2	2.8		370				
UI-30.v	1.4	3		435				
UIII-30.n	0.2	1		140				
UIII-30.n	0.4	1.2		280				
UIII-30.n	0.6	1.4		425				
UIII-30.n	0.8	1.6		565				
UIII-30.n	1	1.8		705				
UIII-30.v	1.2	2		845				
UIII-30.v	1.4	2.2		985				
UIII-30.v	1.6	2.4		1130				
UIII-30.v	1.8	2.6	720	1270	49	108	45	99
UIII-30.v	2	2.8		1410				
UIII-30.v	2.2	3		1550				
UIII-60.n	0.2	1		140				
UIII-60.n	0.4	1.2		280				
UIII-60.n	0.6	1.4		425				
UIII-60.n	0.8	1.6		565				
UIII-60.v	1	2.6		705				
UIII-60.v	1.2	2.8		845				
UIII-60.v	1.4	3		990				
UV-60.n	0.2	1		280				
UV-60.n	0.4	1.2		565				
UV-60.n	0.6	1.4		845				
UV-60.n	0.8	1.6		1130				
UV-60.n	1	1.8		1410				
UV-60.v	1.2	2.45		1690				
UV-60.v	1.4	2.65		1975				
UV-60.v	1.6	2.85	1440	2255	105.6	233	99.8	220
UV-60.v	1.75	3		2465				
UV-60.v	2.4	4.5		2800				
UV-60.v	2.9	4.55		3000				
UV-100.n	0.2	1		280				
UV-100.n	0.4	1.2		565				
UV-100.n	0.6	1.4		845				
UV-100.v	0.8	2.8		1130				
UV-100.v	1	3		1410				
For 10",12" and 14"								
UV-120.n	0.2	1		280				
UV-120.n	0.4	1.2		570				
UV-120.n	0.6	1.4	1440	845	105.6	233	99.8	220
UV-120.v	0.8	2.8		1130				
UV-120.v	1	3		1410				
For 16"								
UV-120.n	0.2	1.2		250				
UV-120.n	0.4	1.5	1440	650	105.6	233	99.8	220
UV-120.v	0.6	3		840				

Note: Side mounted handwheel available on request
Actuator weight remains same irrespective of spring range and actuator action
Above spring ranges are applicable for parabolic trims. For perforated, pressure balanced and three way trims spring ranges will be selected on a case to case basis

Working Principle

Mixing valve (constant flowrate, variable temperature)



Resistance from Point X to Point B = Resistance from Point X to Point A

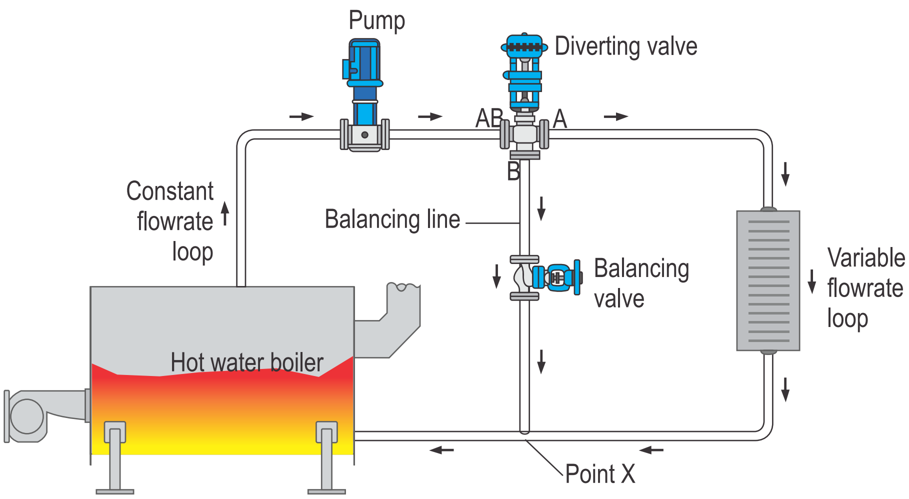
Fig. 6

The amount of heat emitted from the radiators depends on the temperature of the water flowing through the load circuit, which in turn, depends upon how much water flows into the mixing valve from the boiler, and how much is returned to the mixing valve via the balancing line.

It is necessary to fit a balance valve in the balance line. The balance valve is set to maintain the same resistance to flow in the variable flowrate part of the piping network, as illustrated in Figures 6 and 7. This helps to maintain smooth regulation by the valve as it changes position.

In practice, the mixing valve is sometimes designed not to shut port A completely; this ensures that a minimum flowrate will pass through the boiler at all times under the influence of the pump. Alternatively, the boiler may employ a primary circuit, which is also pumped to allow a constant flow of water through the boiler, preventing the boiler from overheating.

Diverting valve (constant temperature in load circuit with variable flow)



Resistance from Point B to Point X = Resistance from Point A to Point X

Fig. 7

The simple system shown in Figure 7 shows a diverting valve maintaining a constant flowrate of water through the constant flowrate loop. In this system, the load circuit receives a varying flowrate of water depending on the valve position.

The temperature of water in the load circuit will be constant, as it receives water from the boiler circuit whatever the valve position. The amount of heat available to the radiators depends on the amount of water flowing through the load circuit, which in turn, depends on the degree of opening of the diverting valve.

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