

lower the steam pressure to less than 58 per cent of the inlet pressures, only the maximum velocity through such valves need be considered. If it is assumed that the valve, when fully open, has an area equal to that of the inlet pipe size, that the steam is flowing into a pressure less than 58 per cent of the initial pressure, that the orifice efficiency is approximately 70 per cent, and that 20 per cent more is allowed for a factor of safety, then the pressure reducing valves will have the working capacities shown in Table 10. If the valve, when fully open, does not give an orifice area equal to that of the pipe on the inlet side, then the capacities will be proportional to the percentage of opening secured, taking the pipe area as 100 per cent. More frequently, difficulty is encountered from the use of pressure reducing valves which are too large in size instead of being

TABLE 10. CAPACITIES OF PRESSURE-REDUCING VALVES
(100-LB GAGE DOWN TO ANY PRESSURE—52 LB OR LESS)

INLET NOMINAL PIPE DIAMETER (INCHES)	POUNDS STEAM PER HOUR AT 100-LB GAGE	EQUIVALENT DIRECT RADIATION Sq Ft AT $\frac{1}{4}$ LB.	EQUIVALENT DIRECT RADIATION Sq Ft AT $\frac{1}{2}$ LB.
$\frac{1}{2}$	866	3,464	2,598
$\frac{3}{4}$	1,576	6,304	4,728
1	2,459	9,836	7,377
$1\frac{1}{4}$	4,263	17,052	12,689
$1\frac{1}{2}$	5,808	23,232	17,424
2	9,564	38,256	28,692
$2\frac{1}{2}$	13,623	54,492	40,869
3	21,041	84,104	63,123
$3\frac{1}{2}$	28,213	112,852	84,039
4	36,285	145,140	108,855
5	56,971	227,884	170,913
6	82,336	329,344	247,008

Formula:

$$\frac{A \times V \times 3600 \times .50}{144 \times 3.88} = \text{pounds per hour passed by orifice.}$$

where

A = area of inlet pipe, square inches.

V = velocity of steam through orifice (approximately 870 fps).

.50 = 70 per cent efficiency of orifice less 20 per cent for factor of safety.

144 = square inches in 1 sq ft.

3600 = seconds in one hour.

3.88 = cubic feet per pound at 100-lb gage.

too small. Where valves are large in size, the valve tends to work close to the seat, causing it to cut out in a relatively short time, as well as being noisy in operation.

Most exact regulation of pressure on steam heating systems is secured from diaphragm-operated valves controlled by a pilot line from the low pressure pipe, taken off the low pressure main at least 15 ft from the reducing valve. The reducing valves operating on the proportional-reduction principle will give a variation of steam pressure on the low pressure side if the initial pressure varies between considerable limits. The so-called dead-end valve is used for reduced pressures where the line has not sufficient condensing capacity at all times to condense the leakage that might occur with the ordinary valve. Single-disc valves do not give as close regulation as double-disc valves, but the single disc is preferable where dead-end valves are necessary, such as on short runs to thermo-

statically controlled hot water heaters, central fan heating units and unit heaters.

The correct installation (Fig. 2) of a pressure-reducing valve includes a pressure-reducing valve with a gate valve on each side, a by-pass controlled by a globe valve, a pressure gage on the low pressure side, and a safety valve on the low pressure main at some point, usually within a reasonable distance of the pressure-reducing valve. Pressure-reducing valves should have expanded outlets for sizes greater than 2 in. Where the steam main is of still larger diameter than the expanded outlet, and in cases where straight valves are used, an increaser is placed close against the outlet of the valve to reduce the velocity immediately after passing through the valve. Strainers are recommended on the inlets of all pressure-reducing valves. A pressure gage may be located on the high-pressure line near the valve if desired.

Owing to the large variation in steam demand on the average heating system, it is generally advisable to use two pressure-reducing valves con-

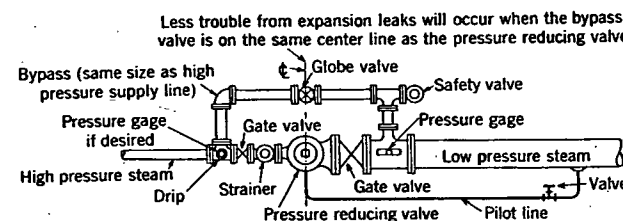


FIG. 2. TYPICAL PRESSURE-REDUCING VALVE INSTALLATION

nected in parallel. One valve should be large enough for the maximum load and the other should have a diameter approximately half that of the first. The smaller valve can be used most of the time, for it will give much better regulation than the larger one on light or normal loads.

Control Valves

Gate valves are recommended in all cases where service demands that the valve be either entirely open or entirely closed, but they should never be used for throttling. Angle globe valves and straight globe valves should be used for throttling, as done on by-passes around pressure reducing valves or on by-passes around traps.

EXPANSION IN STEAM AND RETURN LINES

Because all steam and return lines expand and contract with changes in temperature, provision should be made for such movement. The expansion in steam supply pipes is normally taken at $1\frac{1}{4}$ to $1\frac{1}{2}$ in. per 100 ft and in return lines at one-half or two-thirds of this amount. It may be calculated accurately if the temperature rise and fall can be determined with reasonable certainty (Chapter 18). The temperature at the time of erection often has a greater expansion effect on piping than the temperature in the building after it has been put into service.