preferably of the non-return type, especially if the other air valves on the old system are non-return valves.

Tilting traps used for discharging to a higher or a lower pressure are provided with two or three valves operated by the action of the trap. In the case of the two-valve tilting traps, one valve closes a steam inlet and the other valve opens a vent outlet while the trap is filling and as soon as the trap dumps the first valve opens the steam inlet and the second valve closes the vent outlet, while the trap discharges. In this type of trap there must be a swinging-check valve on each side of the trap, in addition to the usual by-pass, to prevent the pressure in the trap, while discharging, from backing up through the inlet and the pressure in the discharge line from backing up into the trap while it is filling. This type of trap will blow steam out through the vent while filling, if the pressure on the inlet side is sufficient, and should not be used, therefore, with such pressures unless the vent is properly piped back into the return to a feed water heater, condenser or to a perforated pipe in the bottom of the receiver to which the trap discharges in such a way as to prevent the escape of the steam that comes in with the condensate and passes through the vent. In the three-valve traps of this type there is an extra valve for closing the discharge while the trap is filling.

High pressure traps should not discharge directly into a vacuum return because of the vapor formed by the re-evaporation of a part of the hot condensation. Fig. 2 shows a method which may be used for disposing of the greater part of the vapor of re-evaporation.

Direct Return Traps

In the general heating plant, where thermostatic traps are installed on the heating units, it becomes necessary to provide a means for returning the water of condensation to the boiler, if a condensation or vacuum pump is not used. When the return main can be kept sufficiently high above the boiler water line for all operating conditions, the water of condensation will flow back by gravity, and no mechanical device is required. But actually this does not work out in practice. It follows, therefore, that a direct return trap is needed for the handling of the condensation even though it may not be called into action except under some operating condition where the pressure differential exceeds the static head provided. The installation of a direct return trap assures safety for such systems, and the operation of the plant under varying conditions.

Direct return traps, sometimes called alternating receivers, may be of the counterbalanced, tilting type, or spring actuated. These consist of a small receiver with an internal float, and when the condensate will not flow into the boiler under pressure, it will feed into the receiver of the trap, and in so doing, raise or tilt the float or mechanism which actuates a steam valve automatically. This admits steam to the receiver, at boiler pressure, and the equalizing of the pressures which follows, allows the water to flow into the boiler. Fig. 3 shows a direct return tilting trap and receiver properly connected for automatically feeding a boiler from a system of returns delivering the condensate to the receiver.

Chapter 11

PIPE, FITTINGS, VALVES AND PIPE WELDING

Pipe; Types of Pipe, Expansion and Contraction: Fittings; Screwed Fittings, Flanged Fittings: Valves; Pressure Requirement: Corrosion: Pipe Welding.

PIPE

THE term *pipe,* while used as a general term to designate any kind of tube for the conveying of fluids, ordinarily refers to pipe made by shaping sheets of metal into cylindrical form and welding the edges together. Pipe made by forming or drawing from a solid billet is termed *seamless tubing* or *seamless pipe. Welded pipe* is usually made by either the forge lap-weld or butt-weld process, depending upon the size.

Wrought pipe up to 12 in. in diameter is usually designated by its nominal internal diameter which is slightly different from its actual internal diameter, being considerably less in the smaller sizes than the actual dimension. There are three weights of wrought iron and steel pipe commonly used, known as *standard, extra strong,* and *double-extra strong.* Because of the necessity of maintaining the same external diameter in all three weights, for the same nominal size, the added wall thickness is obtained by decreasing the internal diameter.

The term *full weight,* when applied to sizes below 8 in., means that the pipe is up to the nominal weight per foot. When applied to sizes between 8 and 12 in. inclusive, it often indicates that the pipe has the heaviest of the various wall thicknesses listed. In sizes 14 in. and upward pipe is designated by its outside diameter (O.D.) and the wall thickness is specified.

The dimensions of standard and extra strong pipe are given in Tables 1 and 2. The use of double extra strong pipe is limited almost entirely to high pressure hydraulic work.

Types of Pipe

Wrought-Steel Pipe. Because of its low price, the great bulk of wrought pipe used at the present time is of wrought steel. The material used for steel pipe is a mild steel made either by the Bessemer or basic open-hearth process or by the electric furnace.

Wrought-Iron Pipe. The correct definition of wrought iron as suggested by the *International Society for Testing Materials* is "malleable iron which is aggregated from pasty particles without subsequent fusion and contains so little carbon that it does not harden usefully when cooled rapidly."

The chief advantage claimed for wrought iron is to resist corrosion to a greater degree than does steel. This is held to be due to the high degree