principally to insure satisfactory and economical service to the consumer. There are certain fundamental principles that should be followed in the design of a building heating system which is to be supplied from street mains. Although some of these apply to any building, they have been demonstrated to be especially important when steam is purchased.

1. Provision should be made for conveniently shutting off the steam supply at night and at other times when heat is not needed.

It has been thoroughly demonstrated that a considerable amount of heat can be saved by shutting off steam at night. Although there is, in some cases, an increased consumption of heat when steam is again turned on in the morning, there is a large net saving which may be explained by the fact that the lower inside temperature maintained during the night obviously results in lower heat loss from the building, and less heat need therefore be supplied.

Steam can be entirely shut off at night in most buildings, even in very cold weather, without endangering plumbing. It is necessary, however, to have an ample amount

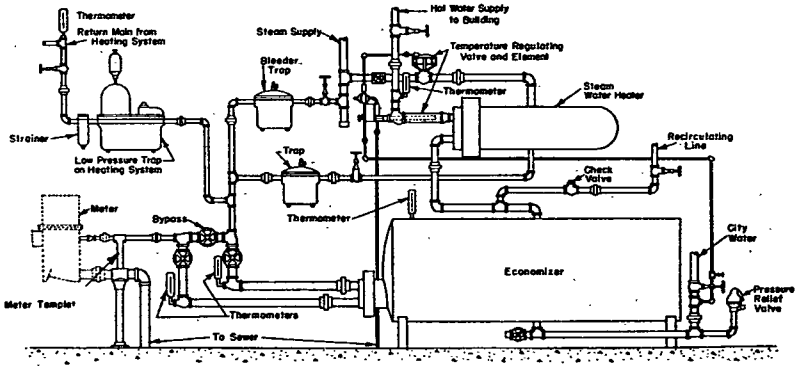

FIG. 5. METHOD OF INSTALLING A WATER HEATER AND ECONOMIZER IN A GRAVITY HEATING SYSTEM

of heating surface so that the building can be quickly warmed in the morning. Where the hours of occupancy differ in various parts of the building, it is good practice to install separate supply pipes to the different parts. For example, in an office building with stores or restaurants on the first floor which are open in the evening, a separate main supplying the first floor will permit the steam to be shut off from the remainder of the building in the late afternoon. The division of the building into zones, each with a separately controlled heat supply, is sometimes desirable, as it permits the heat to be adjusted according to variations in sunshine and wind.

2. Residual heat in the condensate should be salvaged.

This heat may be salvaged by means of a cooling coil, or as is more frequently done, by a water heating economizer (see Fig. 5) which preheats the hot water supply to the building.

The condensate from the heating system, after leaving the trap, passes through the economizer. The supply to the hot water heater passes through the economizer, absorbing heat from the condensate. If the hot water system in the building is of the recirculating type, the recirculating connection should be tied in *between* the economizer and the water heater proper, not at the economizer inlet, because the recirculated hot water is itself at a high temperature.

Because of the lack of coincidence between the heating system load and the hot water demand, a greater amount of heat can be extracted from the condensate if storage capacity is provided for the preheated water. Frequently, a type of economizer is used in which the coils are submerged in a storage tank.

3. Heat supply should be graduated according to variations in the outside temperature.

The maximum in economical operation and satisfactory heating can only be obtained by the use of automatic temperature control (See Chapter 38).

METERING

The perfection of fluid meters has contributed as much to the advancement of district heating as any other one thing. Meters are classified into two groups: *Condensate Meters* and *Rate of Flow Meters.*

Condensate Meters

The one type of quantity meter used is the condensate meter, which may be of the *tilting bucket* or *revolving drum* type.

The condensate meter is a popular type for use on small and medium

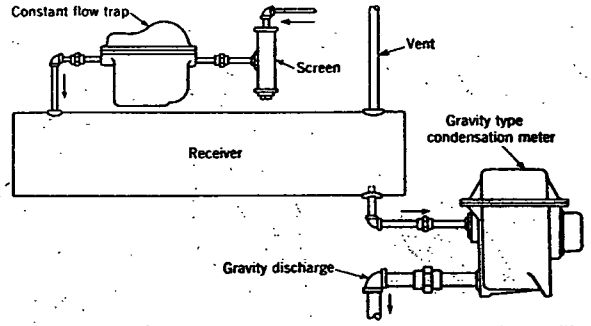

FIG. 6. GRAVITY INSTALLATION FOR CONDENSATION METER USING VENTED RECEIVERS

sized installations, where all the condensate can be brought to a common point for metering purposes. Its simplicity of design, ease in testing, accuracy at all loads, low cost, and adaptability to low pressure distribution have made it standard equipment with many heating companies.

Condensate meters should not be operated under pressure; they are made for either gravity or vacuum installations. Where bucket traps are used, a vented receiver is essential ahead of the meter. Where continuous flow traps are used, a vented receiver is not necessary, but is desirable. Fig. 6 illustrates a gravity condensate meter installation using a vented receiver.

Rate of Flow or Flow Meters

Flow meters used for district heating work are of three types: *Area Meters*, *Head Meters* and *Velocity Meters.* (See Chapter 4, Fluid Flow.)

Area meters are those in the operation of which a variation in the cross-section of stream, under constant head, is used as an indication of the rate of flow. A tapered plug is suspended in an orifice and moves axially with the flow, which is vertically upward. The weight of the plug provides a definite pressure differential, and the plug floats at such a height as will provide enough orifice area to pass the flow at the pressure difference. The