temperatures and quick heating-up; to control and direct the heated air for the positive and economical placing of the heat where it is effective; to distribute heat over wide areas, to reduce the number of units and simplify piping and installation; to increase the capacity of the heating surface by passing the air over it at high velocity to economize material; to provide a system by which room temperatures are easily controlled manually or by thermostats at slight cost.

There is a type of unit heater to suit any purpose. Most employ a heating coil to be supplied with steam or hot water. Some are designed primarily for mounting on the floor, others for suspension overhead. Heating surfaces in the form of pipe coils, non-ferrous tubes or shapes with extended surfaces, cast iron, pressed and built up sections of the cartridge or automotive type are all used in one or more of makes available. Fans employed are the disc or propeller, housed centrifugal and cone types.

Unit heaters may be arranged to re-circulate the air or to supply warmed air from the outside for ventilation or to make up air exhausted. One type combines a means for exhausting air with the above functions. In addition to their prime function of plant heating, they may be adapted to a number of industrial processes, such as drying, curing, etc. Here the use of heated air in more rapid circulation with uniform distribution is of particular advantage. They may be used for moisture absorption, such as fog removal in dye houses or the prevention of condensation on roofs or cold surfaces of buildings where process moisture is given off. When such conditions are bad, it is necessary that the heaters draw air from outside in enough volume to provide a rapid air change and that they operate in conjunction with ventilators or fans for exhausting the moisture laden air.

Unit heaters are made to operate on hot water, vacuum or vapor steam systems or steam at any pressure up to 200 lb. or more. When high pressure steam is used, a heater must be selected with the coil especially designed to withstand the maximum pressure that will exist.

It is usual to rate unit heaters in B.t.u. per hour at a given temperature of air entering the heater and a given steam pressure maintained on the coil. Steam at 2 lb. pressure and air entering at 60 deg. fahr. are taken as standard. The B.t.u. capacity of a heater increases as the steam pressure increases, and decreases as the entering air temperature increases. The B.t.u. capacity for any condition of steam pressure and entering air temperature may be calculated from any given rating by the use of factors in Table 1.

The B.t.u. required to heat a building with unit heaters is determined in the same way as for any other heating equipment (Chapter I). Unit heaters of the number and size needed to furnish this B.t.u. are then selected from the manufacturers rating tables, using their ratings at the steam pressure to be used and at the temperature at which the air will enter the heater. For re-circulating heaters with intakes at the floor level, use the temperature to be maintained in the room as the temperature of the air entering the heater. For suspended heaters re-circulating, the entering air temperature will be higher than the specified room temperature by approximately 1 deg. fahr. for each foot of elevation between the 5 ft. level and the level of the heater intake. Heaters

Table 1. B.t.u. Constants for Various Steam Pressures and Temperatures of Entering Air

Steam Pressure Lbs.	Temperature of Air Entering Heater												
	−10°	0°	10°	20°	30°	40°	45°	50°	55°	60°	65°	70°	75°
0	0.975	0.93	0.89	0.84	0.80	0.76	0.73	0.71	0.69	0.67	0.64	0.62	0.60
2	1.01	0.96	0.92	0.87	0.83	0.79	0.76	0.74	0.72	0.70	0.68	0.65	0.63
5	1.04	**1.00**	0.96	0.91	0.87	0.82	0.80	0.78	0.76	0.74	0.71	0.69	0.67
10	1.06	1.05	1.01	0.97	0.92	0.88	0.85	0.83	0.81	0.79	0.76	0.74	0.72
15	1.15	1.10	1.05	1.01	0.97	0.92	0.90	0.88	0.86	0.83	0.81	0.79	0.76
20	1.18	1.14	1.09	1.05	1.00	0.96	0.94	0.92	0.89	0.87	0.85	0.83	0.81
30	1.25	1.21	1.16	1.12	1.08	1.03	1.01	0.98	0.96	0.94	0.92	0.90	0.88
40	1.30	1.26	1.22	1.17	1.12	1.08	1.06	1.04	1.02	1.00	0.97	0.95	0.93
50	1.35	1.31	1.27	1.22	1.18	1.13	1.11	1.09	1.07	1.04	1.02	1.00	0.98
60	1.39	1.35	1.31	1.26	1.22	1.18	1.16	1.13	1.11	1.09	1.07	1.05	1.03
80	1.49	1.43	1.38	1.34	1.29	1.25	1.23	1.20	1.18	1.16	1.14	1.12	1.10
100	1.53	1.49	1.44	1.40	1.35	1.31	1.29	1.26	1.24	1.22	1.20	1.18	1.16
125	1.59	1.56	1.51	1.46	1.42	1.37	1.36	1.33	1.31	1.29	1.27	1.24	1.22
135	1.61	1.57	1.53	1.48	1.44	1.39	1.37	1.35	1.33	1.30	1.28	1.26	1.24
140	1.62	1.58	1.54	1.49	1.45	1.41	1.38	1.36	1.34	1.32	1.29	1.27	1.25
150	1.64	1.60	1.55	1.51	1.46	1.42	1.40	1.38	1.35	1.33	1.31	1.28	1.26

Note.—To get B.t.u's at any steam pressure and entering temperature, multiply constant from table by rated B.t.u's at 0 deg. entering and 5 lb. pressure.

supplied with super-heated steam will have less B.t.u. capacity than with saturated steam at the same pressure. When superheated steam is supplied or when the steam in the heater coils is superheated by throttling from the heater at a higher line pressure, the heater manufacturer should be asked for a special rating for the conditions of the case.

The present day tendency for straight heating is to use steam at low-pressure when the boiler supplies steam for heating purposes only and when the transmission lines are short. Many industrial plants, however, generate steam at high pressure either for long distance transmission or process uses. When such high pressure steam is available in sufficient quantity for the heating load, it is most often more economical to select heaters with coils good for high pressure. Thus the line pressure may be turned into the coils directly without reducing valves, fewer or smaller heaters can be used and the condensation can be boosted to overhead returns whenever desirable to do so.

Among the unit heaters available are types having from one to four outlets that can be arranged to discharge in selected directions and that will project their heating effect over distances of from 30 to 200 ft. from the heater, depending upon the capacity of the heater and the design of the fans and outlets. This leaves the engineer comparatively free to select the heater location best suited to the production layout.

The smaller capacity propeller fan type heaters with outlet velocities from 300 to 600 ft. per minute may be placed from 60 to 100 ft. apart. The larger capacity housed fan high outlet velocity heaters may be placed up to 400 ft. apart, depending upon their design. Heaters may be distributed through the central portions of a room discharging toward exposed surfaces, or spaced around the walls, discharging along the walls and inward as well, when there are considerable roof losses. In general, it is better to direct the discharge from the unit heater in