spray chamber where the air is washed and humidified and then passes through eliminators into the lower portion of the furnace casing. (See cross section Fig. 13). If desired a cooling element and mechanical refrigeration may be added for cooling in summer.

In Fig. 14 return air from the rooms is drawn by a fan through a dry mat type air filter and is then delivered into the bottom of the furnace casing. While this unit makes no attempt to utilize cooling water or refrigeration, humidification during the winter is obtained from humidifiers located in the furnace.

A more elaborate unit, Fig. 15, for heating and cooling employs a cloth filter of bag design and a double element for heating and cooling. In summer, water is run through both elements either direct from the street main or from some mechanical cooling equipment, while in the winter hot water is supplied from a hot water boiler using the same surface.

These units are provided with a single element in order to reduce first cost and, when so equipped, will do everything that the double element unit will accomplish except that less cooling is available in the summer. Humidity is provided by spraying water between the two elements. Noise is reduced by the use of rubber pads under the bedplate supporting the fans and by the connecting of the fans to the metal work of the discharge through canvas connections. Fig. 15 shows the outer casing removed.

Another design using hot water heating boilers is given in Fig. 16 where the unit takes air from both inside and outside, utilizing hot water from the boiler for winter heating and water, either iced or mechanically cooled, for summer cooling. The boiler may be coal, oil or gas fired and the air is humidified or dehumidified as the conditions require; the same element is utilized for heating and cooling, the piping being cross connected.

Where gas can be used, Fig. 17 shows a unit consisting of an air filter, motor-driven fan, air washer and gas-fired steel furnace which warms the air during the winter season. No refrigeration is used with this equipment, the idea being that the air washer during the summer will lower the air temperature sufficiently when the humidity is low while at night, the apparatus is run without the washer when the air is cooler but of relatively higher humidity.

For oil fuel the unit shown in Fig. 18 can be installed to obtain filtered, warmed and humidified air. An oil burner and a heat exchanger provide the heat. A cooling section may be inserted between the fan and the heat exchanger, cold water being circulated through the cooling element. This equipment is completely automatic and is thermostatically controlled. A room thermostat starts the oil burner whenever the temperature falls and the rising temperature in the heat exchanger causes a second thermostat to start the fan. As soon as the temperature in the house rises to normal the room thermostat shuts down the oil burner which in turn operates the thermostat controlling the fan.

Chapter 13

UNIT HEATERS AND VENTILATORS

Types of Unit Heaters, Heating Media, Entering and Delivery Temperature, Output of Unit Heaters, Direction of Discharge, Boiler Capacity, Direct-Fired Units, Unit Ventilators, Split and Combined Systems, Location of Unit Ventilators, Capacities

A UNIT heater consists of a combination of a heating unit and a fan or blower having a common enclosure, and placed within or adjacent to the space to be heated. Generally, no ducts are attached to the inlets or outlets. A unit ventilator is similar in principle of operation to a unit heater, but is designed to use all or part out-door air with or without alternate provision for handling recirculated air. Unit heaters are designed mainly for factory and industrial use, whereas unit ventilators are intended largely for school and office ventilation and heating.

Unit heaters are designed to:

1. Circulate the air in the building at a rapid rate.
2. Promote uniformity of temperature and quick heating-up.
3. Direct the heated air so as to accomplish the positive and rapid placing of the heat where it is effective.
4. Reduce the temperature differential between floor and ceiling.
5. Reduce the number of heat emitting units and simplify piping and installation.
6. Increase the capacity of the heating surface by passing the air over it at high velocity.
7. Provide a system by which room temperatures are readily controlled manually or by thermostats.

TYPES OF UNIT HEATERS

There are many types of unit heaters available. Most of them employ heating coils to be supplied with steam or hot water. Some are mounted on the floor, whereas others are designed for suspension overhead. Heating surfaces in the form of pipe coils, non-ferrous tubes or shapes with extended surfaces, cast-iron, and pressed and built-up sections of the cartridge or automotive type are all used in unit heater construction.

Among the unit heaters available are types having from one to four outlets per heater which may be arranged to discharge in selected directions and which will project their heating effect over distances of from 30 to 200 ft from the heater, depending upon the capacity of the heater and upon the design of the fans and outlets. These heaters have been successful when placed as far as 400 ft from each other. This makes it possible to select the heater location best suited to the production layout in factories. There are available propeller fan type heaters of smaller