

7. *Column conductor*—the cast-iron column type of radiator not manufactured since 1928.
8. *Tube conductor*—the cast-iron radiator of 1931.
9. *Wall conductor*—the wall type of cast-iron radiator of 1931.

Until recent years practically all conductors for various heating purposes were made of cast-iron, of steel pipe, or of pressed sheet iron, and the types were well standardized so that data on heat output could be given which were applicable to all makes. Several years ago the design of cast-iron conductors was changed, resulting in a greater heat output for a given weight, a more attractive product, and greater variation in the design and sizes of conductors on the market.

There are many new types of heaters for all types of service made of non-ferrous metals, which lend themselves to construction of much lighter and smaller units for a given heat output. Cast-iron heaters are still used predominantly as conductors, but non-ferrous convectors are rapidly replacing cast-iron convectors for cabinet, concealed, and blast heating. Extended surface, as contrasted with direct surface, is a characteristic feature of most of the new designs of non-ferrous metal convectors.

UNIT OF HEAT OUTPUT

In the past the unit of measure recognized in computing heat emission of radiators was the square foot of actual radiating surface. The use of this unit is being discarded rapidly, however, for the reason that heat emission depends upon the design of the heater as well as upon its surface area. The engineer is interested primarily in the amount of heat emitted by, rather than the amount of surface in a heat-transferring agent. As a result, heaters are now rated on the heat given off either in Btu per hour or in equivalent square feet, based on 240 Btu per hour, and there is a growing demand for a new measure which will express also the room-comfort effect of the heater.

The purpose of supplying heat to a room is not alone to increase the temperature of the building, but also the purpose often is to maintain a condition of comfort for the occupants. In this connection it cannot be denied that comfort-feeling for human beings in winter calls for the delivery of warmth to the lower part of the room or to the zone of occupancy, instead of for overheating the parts near the ceiling. Recognition of this principle has led to considerable study and speculation on economical application or distribution of heat in domestic heating.

One scheme for securing maximum comfort in the zone of occupancy with minimum heat loss is the use of heaters which give off the greater part of their heat by radiation directly to the occupants in the lower or occupied portion of the room, without unduly heating the upper part of the room.

Another method of accomplishing the same result is in the proper use and application of concealed and cabinet heaters, whereby the heat is transferred to the room by means of heated air continuously projected horizontally slightly above the plane of occupancy of the room and replaced by an equal volume of cooler air drawn into the base of the cabinet convector from the floor, thus creating a local circulation within the zone of occupancy and tending to prevent overheating of the air in the upper part of the room.

FACTORS AFFECTING THE HEAT EMISSION

Many radiator tests, made under actual service conditions, have indicated that the type and placement of the radiator, the temperature and the finish of the radiating surfaces, and the radiator enclosure (if such be used) have a marked influence upon the heating effect of a radiator in a room, and the amount of steam condensation or heat utilization of the radiator.

Temperature

The heat emission depends upon the difference in temperature between the heating medium in the conductor or convector, and the temperature of the surrounding air. The exact relationship depends upon the design of the heater and the relative proportion of conducted and convected heat. However, the Code of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS for Testing Radiators, assumes the following relationship as applicable to the average run of direct cast-iron conductors.

$$H = K (T_s - T_r)^{1.3}$$

where

H = the rate of heat emission in B.t.u. per hour per square foot of surface.

K = a constant.

T_s = the temperature of heater assumed to be the temperature of the steam or hot water.

T_r = the temperature of the room in which the heater is located.

The Society's Code also accepts 215 deg. and 70 deg., respectively, as standard steam and room temperatures. Accepting this assumption, the heat emission for any other than standard conditions is equal to:

$$H_x = H_s \left(\frac{T_s - T_r}{215 - 70} \right)^{1.3}$$

where

H_s = the heat emission under standard conditions.

If the conductor or convector is to be used under any other than standard conditions of room and steam temperature, this fact should be given consideration. This may be done by applying the foregoing formula to the standard heat output of the heater or more conveniently by multiplying its standard heat emission by the proper factor taken from Table 1. In estimating the size of heater required for a room under other than standard conditions divide the estimated heat loss from the room by the factor for the prevailing conditions as given in Table 1, and choose a heater which will supply this corrected heat loss when operating under standard conditions. Thus, if a room whose heat loss with 60 deg. air is 7,200 B.t.u. per hour, is to be heated to 60 deg. with steam at 200 deg., divide 7,200 by 0.955 giving 7,539, and pick a heater which will give 7,539 B.t.u. per hour when supplied with 215 deg. steam in a 70 deg. room.

Heating the Conductor

It is often very important to know the maximum condensation that occurs in a heater when steam is turned on, Fig. 1 shows the conden-