

2. *Recessed conductor*—a heater set back into a wall recess but not enclosed in any way. A flat surface wall panel heater is a panel conductor.
3. *Convactor*—a heater which is enclosed in a duct or cabinet and which gives off the heat to an air stream, which passes into the room which is to be heated.
4. *Cabinet convactor*—a heater placed in an enclosure located within the room which is to be heated.
5. *Indirect convactor*—a heater placed exterior to the room which is to be heated. There are both gravity indirect convectors and blast indirect convectors.
6. *Direct-indirect heater*, or conductor—convactor—a heater arranged so that some of its sections operate as convectors, being partially housed in so as to heat air which enters from outside the room, while other sections and part of the housed sections may operate as conductors.
7. *Column conductor*—the cast-iron column type of radiator not manufactured since 1926.
8. *Tube conductor*—the cast-iron radiator of 1930.
9. *Wall conductor*—the wall type of cast-iron radiator of 1930.

The past few years have seen a greater variation and multiplicity of design in heaters for various purposes than has been experienced in any other branch of the heating industry. Until quite recently, practically all conductors for all purposes were made of cast-iron, of steel pipe, or of pressed sheet steel, and types were well standardized so that data on heat output could be given which were applicable to all makes. More recently the design of cast-iron conductors has 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 heating 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 B.t.u. per hour or in equivalent square feet, based on 240 B.t.u. per hour, and there is a growing demand for some sort of 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 especially designed to 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 convactor 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

The heat emission from a heater is affected by a number of conditions. These include the temperature and the moisture in the air of the room, the temperature of the steam or hot water in the heater, the speed of circulation of the air over the heater, the kind of paint used on the heater, the location of the heater in the room, and whether or not it is in an enclosure.

Temperature

The heat emission depends upon the difference in temperature between the heating medium in the conductor or convactor, 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:

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

where

H_s = the heat emission under standard conditions.

If the conductor or convactor 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 mul-