SPACE HEATERS

Space heaters may be classified in several ways, such as:

1. By the type of fuel used as coal, wood, gas, and fuel oil.

2. According to the method of heat distribution as circulators or radiant types. A radiant heater is one in which the heat exchanger surface is exposed directly to the room atmosphere, and the generated heat is dissipated primarily by radiation. A circulating heater is essentially a jacketed radiant heater from which circulation of room air is promoted by the chimney effect caused by the movement of air passing upward between the jacket and heat exchanger surface.

3. According to method of design for particular fuel types, such as: (a) surface-fired and magazine-feed for solid fuels, (b) vaporizing pot-type and blue-flame heater for oil, and (c) vented and unvented heaters for gas. (The type of gas burner design, such as injection, yellow flame, power, and pressure, may also be mentioned.)

SOLID FUEL-FIRED HEATERS

Surface-fired heaters normally have a front firing door and are operated with relatively shallow fuel beds. A magazine-feed heater includes a deep reservoir of fuel to lengthen the attention intervals. In a true magazine feed heater the rate of fuel ignition would be equal to the rate of burning; and self-feeding should operate to move the unburned fuel by gravity flow from the magazine section into the hearth area. However, the ideal balance between rate of ignition and rate of burning is virtually impossible to attain for any solid fuel under normal usage, although self-feeding may be obtained with wood and some free burning coals. Thus, a magazine-type space heater is essentially a deep surface-fired heater, its principal difference being increased fuel capacity.

Materials and Construction

There is no accepted code governing the construction of solid fuel burning space heaters. In past years cast-iron was used predominantly in the construction of coal and wood heaters, with the exception of the so-called *air-tight* heaters designed as low-cost wood-burning units with little consideration for long life, and stoves were priced on a poundage basis. The present trend is toward fabricated steel parts and welded assemblies, although cast-iron is still used for grates, firebox liners, and parts subject to high temperatures. Refractory firebox liners are also used quite extensively.

Formed sheet steel is used predominantly for the outer jacket of circulator heaters, although heaters with outer casings formed from cast-iron are still readily available. Circulator cabinets normally have surfaces finished with a porcelain enamel, while the casing of a radiant heater is finished with an air-dried japan or a baked enamel.

Both welding and stove bolts are used in unit assembly, and stove cement is used on section joints to prevent air leakage. This latter is extremely important to obtain a low rate of combustion when desired.

Testing and Rating

There is no accepted code governing the method of testing and rating solid-fuel space heaters. A tentative procedure, TS-3443, has been issued by the *Division of Trade Standards, National Bureau of Standards*, but is based on use of anthracite as a rating fuel, although bituminous coals are used predominantly as heating fuels. This procedure, which has been the basis of published ratings, consists of determining the heater output, expressed in Btu per hour, by the indirect method. The measurable heat losses: (1) loss due to moisture in the fuel, (2) loss due to heat in the dry flue gases, (3) loss due to unburned carbon monoxide, and (4) loss due to unburned combustible in the ash and refuse, are measured by test. The total of these four measurable losses, plus an assumed value for unaccounted for losses, are then subtracted from the heat input. The difference multiplied by the burning rate in pounds per hour is the heater output.

When using anthracite as the rating fuel, the unaccounted for loss has been assumed to be zero. It has been accepted practice to use a 20 percent allowance for the unaccounted for losses when burning a bituminous coal. The value of this factor has been under study and, although test work is incomplete, a value of 12 percent of the heat input has been determined as representing the losses due to smoke and unburned hydrocarbons for a surface-fired heater, when burning a high volatile bituminous coal.

No allowance is made for a radiation loss, as this is useful heat.

Design Considerations

Some important considerations in the design of solid fuel space heaters are:

1. Suitable protection by baffling or insulation against overheating of floors and walls. Although there are no industry-accepted standards by which floor and wall temperatures may be determined, some indication of heater performance, with regard to overheating, may be found by the use of the corner booth test arrangement described in *National Bureau of Standards* Commercial Standard CS 103-43 and *Underwriter's Laboratories* Standard, Subject 896, mentioned in following section on Oil Heaters.

2. Tight heater construction to prevent air leakage, and to enable maintenance of a suitably low minimum burning rate. This includes a ground, paper tight joint between the ashpit door and door frame.

3. Sufficient free air space, between the casing and heat exchanger of circulating heaters, to permit free air flow over all surfaces and maintain a suitably low casing temperature.

4. Protection of all metal parts from deterioration due to high temperature. This may be accomplished by: (a) fabrication of certain parts from cast-iron or an alloy iron, (b) protection by a refractory liner, (c) use of high temperature enamel coatings, (d) directing air against hot spots.

5. Proper admission of secondary air to complete the combustion process. Care should be taken to prevent this air from also functioning as primary air.

6. Strength in assembly to prevent transportation and use damage.

Considerable work has been directed in the past few years towards improvement of the performance of bituminous coal-fired space heaters, with particular reference to smokeless operation under conditions of normal operation such as obtained in homes. A recent paper describes the smokeless coal heater developed by *Bituminous Coal Research, Inc.*, wherein smokeless combustion is obtained by admitting secondary air through a narrow slot, extending from side to side, above the edge of the fuel bed where the gas leaves to enter a vertical gas passage.[12] Complete mixing of the volatile material, released from the coal in the magazine, with the secondary air supplied is obtained as both streams pass under the bottom of the arch. Complete combustion results from this intimate mixing in a region which maintains itself at high temperatures even during banking periods.

OIL HEATERS

Vaporizing pot-type oil heaters consist of: (1) a metal pot in the bottom of which the oil is vaporized, the vapors burning at or near the top of the