the successful and safe performance of a gas conversion burner depends on numerous factors other than those incorporated in such equipment, installations of this kind must be made in strict accordance with American Standard Requirements for Installation of Domestic Gas Conversion Burners, *ASA* Z21.8–1948. Also, draft hoods conforming to American Standard Listing Requirements for Draft Hoods, *ASA* Z21.12–1937, should be installed (in place of the dampers used with a solid fuel) on all boilers and furnaces intended to operate without chimney draft. The *A.G.A.* lists the output efficiency of conversion burners at 72 percent. This value is based on average installations and average heating equipment performance.

One form of central heating system is the warm air floor furnace.[5] The use of these furnaces is adaptable to mild climates, or for auxiliary heating or heating of single rooms in colder climates. They are used for heating first floors, or where heat is required in only one or two rooms. A number may be used to provide heat for the entire building where all rooms are on the ground floor, thus giving the heating system flexibility.

In floor-furnace applications, the heating element, gas piping, and flue vent piping are suspended below the floor, and the only part in the room being heated is the circulating air register which may be of the single-type installed in the floor, or of the dual-type installed in a partition, and heating two rooms. The *A.G.A.* rating of floor furnaces is based on an efficiency of 70 percent.

A recent type of central heating, used in mild climates, is the recessed heater which is either a gravity or forced-air furnace designed for installation in the interior partition of a building, and having stub ducts conducting air to two or more rooms. This type of heater is usually installed in new homes, and is plastered into the wall, becoming a permanent part of the building.

Space Heaters

Space heaters are defined as heating units that take the air for combustion from the space being heated. They may be broadly classified as room heaters and unit heaters.

Room heaters are used for heating single rooms or connecting rooms with good circulation between them and, except for wall-type heaters, they are semi-portable. Unvented-type room heaters should not be used unless space is properly ventilated to prevent excess moisture and to provide sufficient combustion air to prevent formation of carbon monoxide. All types of room heaters are capable of automatic control, although they are generally controlled manually. When equipped for automatic control, they must have an automatic pilot as part of the control equipment. Room heaters may be classified as follows:

Circulators, vented and unvented, are small warm air furnaces that heat the room mainly by convection, although some have radiants over the burner, with windows in the front to allow some heat by radiation.

Radiant heaters, usually unvented, although some vented types are available, have a refractory directly above the burners which is heated to incandescence, and gives off at least 30 percent of its heat in the form of radiant energy.

Gas-fired steam and hot water radiators, vented and unvented, are similar in appearance to an ordinary steam or hot water radiator, but are self-contained, and the gas input is controlled by steam pressure or water temperature within the radiator.

Warm air radiators are vented or unvented circulators whose heating elements are constructed in the form of a steam radiator.

Wall heaters, vented or unvented, are usually a type of radiant heater constructed with sufficient insulation (either solid or circulating air) to prevent overheating of the casing, and are built into a wall with the front flush with the wall surface.

The *A.G.A.* rating of room-type heaters is based on an efficiency of 70 percent.

Unit heaters are used extensively for heating large spaces such as stores, garages, and factories. These heaters consist of a burner, heat exchanger, fan for distributing the air, draft hood, automatic pilot, and controls for burners and fan. They are usually mounted in an elevated position from which the heated air is directed downward by louvers. Some unit heaters are suspended from the ceiling, and others are free-standing floor units of the heat tower type. Unit heaters are classified for use with, or without, ducts depending on specific *A.G.A.* approval. When connected to ducts they must have sufficient blower capacity to deliver an adequate air quantity against the duct resistance.

Duct furnaces are usually of the unit heater type without the fan, and are used for heating air in existing duct systems where blowers are provided for moving the air through the system. Duct furnaces are tested for operation at much higher static pressures than are obtained in unit heaters.

Combustion Process and Adjustments

Most domestic gas burners are of the atmospheric injection (Bunsen) type in which primary air is introduced and mixed with the gas in the throat of the mixing tube. For normal operation of most atmospheric type burners, 40 to 60 percent of the theoretical air as primary air will give best operation. Slotted port and ribbon burners may require from 50 to 80 percent primary air for proper operation. The amount of excess air required in practice depends upon several factors, notably: uniformity of air distribution and mixing, direction of gas travel from burner, and the height and temperature of combustion chamber. With power type burners utilizing motor driven blowers to provide both primary and secondary air, the excess air can be closely controlled while securing proper combustion.

Secondary air is drawn into gas appliances by natural draft. As with other fuels, excess secondary air constitutes a loss, and should be reduced to a proper minimum, which usually cannot be less than 25 to 35 percent, if the appliance is to meet *ASA* approval requirements. Yellow flame burners depend upon secondary air, alone, for combustion.

The flame produced by atmospheric injection burners is non-luminous. Air shutter adjustments for manufactured gas should be made by closing the air shutter until yellow flame tips appear, and then by opening the air shutter to a final position at which the yellow tips just disappear. This type of flame obtains ready ignition from port to port, and also favors quiet flame extinction. When burning natural gas, the air adjustment is generally made to secure as blue a flame as is obtainable without lifting of flames from burner ports. Manufacturers' instructions for burner adjustment should be followed.

Gas designed equipment does not usually incorporate any means for varying the secondary air supply (and hence the CO_2). The amount of effective opening and baffling is determined by *A.G.A.* tests and cannot be varied. Gas conversion burners, however, do incorporate means for controlling secondary air to permit adjustment over a wide range of inputs