

are semi-portable. Unvented-type room heaters should not be used in residences, unless provision is made to remove the excess moisture caused by release of the flue gases into the living quarters. 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.

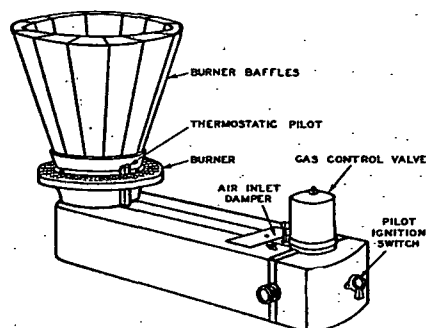


FIG. 20. TYPICAL GAS CONVERSION BURNER

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.

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 available in two types, classified according to their use, with, or without ducts. Only those types of unit heaters tested and approved as warm air furnaces can be connected safely to ducts, as they have sufficient blower capacity to deliver an adequate air supply against duct resistance, and are equipped with limit controls.

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 pro-

vided 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. A ratio of about 5 parts air to 1 part gas for manufactured gas, and a 10 to 1 ratio for natural gas, are generally used as theoretical values of air required for complete combustion. For normal operation of most atmospheric type burners, 40 to 60 percent of the theoretical value as primary air will give best 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.

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. 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.

Little difficulty should be had in maintaining efficient combustion when burning gas. The fuel supply is normally held to close limits of variation in pressure and calorific value, and the rate of heat supply is nominally constant. Because the force necessary to introduce the fuel into the combustion chamber is an inherent factor of the fuel, no draft by the chimney is required for this purpose. The use of a draft hood insures the maintenance of constant low draft conditions in the combustion chamber with a resultant stability of air supply. A draft hood is also helpful in controlling the amount of excess air and preventing back drafts that might extinguish the flame. (See Chapter 13.)

Due to the use of draft hoods and gas pressure regulators, both the input and combustion conditions of gas appliances are maintained quite uniform until deposits of dirt, corrosion, or scale accumulate in the air inlet openings, burner ports, or on the heating surface. Periodic cleaning is necessary to keep any gas appliance in proper operating condition.

Measurement of the Efficiency of Combustion

The efficiency of combustion may be judged from the percentage of carbon dioxide (CO_2), oxygen (O_2) and carbon monoxide (CO) in the flue gases. The CO_2 and O_2 may be obtained by means of an Orsat apparatus, but the CO must be determined by more accurate equipment. It is customary to use simple indicators to determine whether CO is present, and to make adjustments of the appliances to reduce the CO below 4/100 of one percent before continuing tests in which the CO_2 and O_2 can then be found by use of the Orsat apparatus. Since the ultimate CO_2 for any gas depends on the carbon-hydrogen ratio, the quality of the combustion