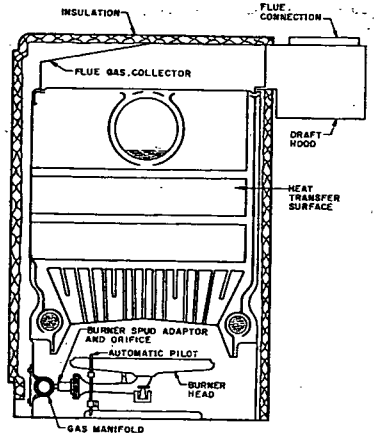

Fig. 9 .... Gas-fired Boiler

heat output rating is 75 percent of the approved heat input to the burners for fan-type units, and 70 percent for gravity-type units.

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 either single rooms or connecting rooms with good circulation between them, and, except for wall-type heaters, they are semiportable. 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 can be automatically controlled, 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, 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. Some circulators are available with *sealed combustion chambers*, so that they take combustion air from outdoors, near the flue gas terminal.

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 an appreciable part of its heat in the form of radiant energy.

Wall heaters 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. Their heat input rating is limited to a maximum of 25,000 Btuh.

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. Heat output is required to be at least 75 percent of heat input to the burners.

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.

COMMERCIAL AND INDUSTRIAL

There are many basic types of industrial gas burners, but only those commonly used for heating service will be covered here. These burners may be either of the atmospheric or power type.

Atmospheric Burners

Burners of the atmospheric type are most frequently made up of a multiple of tubes or burners, each with a Venturi, gas orifice, and burner heads. These burners are of inshot or upshot design.

Inshot burners are placed horizontally, making them particularly adaptable to firing Scotch-type boilers. Upshot burners are arranged vertically, making them more adaptable in firebox type boilers.

Power Burners

Burners of the power type employ a fan to supply and control combustion air. These burners can be of either natural draft or forced draft type.

In *natural draft* installations, a chimney is required to draw the products of combustion through the boiler or furnace; the burner fan supplies only enough power to move the air through the burner. Many natural draft power burners have a configuration similar to that of an inshot atmospheric burner to which a fan and windbox have been added. More complex

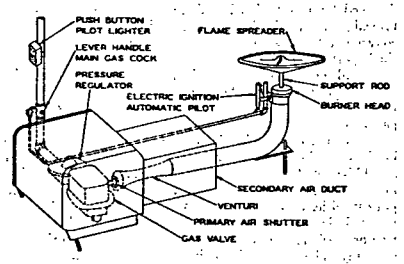

Fig. 10 .... Typical Single-Port Gas Conversion Burner

Table 2.... Capacity of Gas Piping—Cu Ft Per Hr
(At pressure drop of 0.3 in. water. Specific gravity = 0.60)

Length of Pipe Ft	Iron Pipe Size (IPS) Inches									Length of Pipe Ft
	½	¾	1	1¼	1½	2	2½	3	4	
10	132	278	520	1,050	1,600	3,050	4,800	8,500	17,500	10
20	92	190	350	730	1,100	2,100	3,300	5,900	12,000	20
30	73	152	285	590	890	1,650	2,700	4,700	9,700	30
40	63	130	245	500	760	1,450	2,300	4,100	8,300	40
50	56	115	215	440	670	1,270	2,000	3,600	7,400	50
60	50	105	195	400	610	1,150	1,850	3,250	6,800	60
70	46	96	180	370	560	1,050	1,700	3,000	6,200	70
80	43	90	170	350	530	990	1,600	2,800	5,800	80
90	40	84	160	320	490	930	1,500	2,600	5,400	90
100	38	79	150	305	460	870	1,400	2,500	5,100	100
125	34	72	130	275	410	780	1,250	2,200	4,500	125
150	31	64	120	250	380	710	1,130	2,000	4,100	150
175	28	59	110	225	350	650	1,050	1,850	3,800	175
200	26	55	100	210	320	610	980	1,700	3,500	200

From *American Standard Installation of Gas Appliances and Gas Piping*, ASA Z21.30-1959.

gas-air mixing patterns are possible, and combustion capabilites are thereby improved.

The fan size and speed on power burners have been gradually increased and the combustion process modified so that the fan not only moves air through the burner, but also forces it through the boiler. Only a vent is required to release the flue gas products at a height above a nuisance level and combustion occurs under pressure. These burners are classified as forced draft burners. In a *forced draft* power burner, gas input is usually controlled by throttling valves or equivalent means external to the burner. The gas is introduced into a controlled air stream designed to produce thorough gas-air mixing but still capable of maintaining a stable flame front. In a ring burner, the gas is introduced into the combustion air stream through a gas filled-ring just ahead of the combustion zone. In a premix burner, gas and primary air are mixed together, and the mixture is then introduced into secondary air in the combustion zone.

The power burner affords superior control of combustion, particularly in restricted furnaces and under forced draft conditions.

Commercial and industrial gas burners can frequently operate from higher gas pressures than are employed for domestic equipment. It is necessary to determine both maximum and minimum gas pressures to be applied to the controls of these burners. If the maximum gas pressure exceeds the 14 to 18 in. standard for domestic equipment, appropriate consideration must be taken in the selection of burner control equipment.

Infrared Heaters

Infrared heaters, vented or unvented, are used extensively for heating factories, foundries, sports arenas, loading docks, garages, and other installations where convection heating is difficult to apply. There are two general types of gas-fired infrared heaters:

1. Surface combustion radiant heaters which have a ported refractory or metallic screen burner face through which a self-sufficient mixture of gas and air flows. The gas-air mixture burns on the surface of the burner face heating it to incandescence and releasing heat by radiation. These units operate at surface temperatures of about 1600 F, are generally unvented, and have rated inputs up to 50,000 Btu per hour per unit.
2. Internally-fired heaters which consist of heat exchanger with the exposed surface radiating heat at a surface temperature of approximately 800 F. The exposed surface can be equipped with reflecting louvers or a single large reflector to direct the radiated energy. Units of this type are available with rated inputs up to 125,000 Btu per hour and are usually vented.

Infrared heaters of the types described above are usually mounted in elevated positions and radiate heat downward. For further information, see Chapter 14 of the 1964 Guide And Data Book.

Sizing of Gas Piping

Piping for gas appliances should be of adequate size, and so installed as to provide a supply of gas sufficient to meet the maximum demand without undue loss of pressure between the point of supply (the meter) and the appliance. The size of gas pipe required depends upon the following:

1. Maximum gas consumption to be provided.
2. Length of pipe and number of fittings.
3. Allowable loss in pressure from the outlet of the meter to the appliance.
4. Specific gravity of the gas.

To obtain the cubic feet per hour of gas required by the appliance, divide the Btu input rate at which the appliance will be adjusted by the average Btu heating value per cubic foot of the gas.

Capacities of different sizes and lengths of pipe, in cubic feet per hour, with a pressure drop of 0.3 in. of water column for a gas of 0.60 specific gravity, are shown in Table 2. In adopting a 0.3 in. pressure drop, due allowance for an ordinary number of fittings was made.

To convert the values given in Table 2 to capacities for another gas of different specific gravity, multiply the tabular values by the multipliers shown in Table 3.

Pipe capacities for gas flow up to 100,000 cfh for various lengths of pipe are given in Fig. 11 which is based on a specific gravity of 0.60. The capacity at a given pressure loss for a