Another classification of burners used is with reference to the means employed to prepare the fuel for combustion. The terms are vaporizing and atomizing burners.

In the vaporizing burner the fuel is prepared for combustion by the addition of heat. The heat serves to convert the liquid fuel into a vapor which is mixed with the air for combustion either just before or during the combustion process. Blue flame combustion is sometimes advocated but as a blue flame radiates very little heat it is of no particular advantage in a boiler or furnace that has been designed for coal burning, wherein the major heat transfer is secured through radiation. By vaporizing the fuel, moving parts can be eliminated and it is easy to control at low combustion rates. However it requires a light fuel for best results and with poor design there is the possibility of carbon trouble due to "cracking" or decomposition of the oil in the vaporizing chamber.

In the atomizing burner the fuel is broken into a fine mist which is mixed with the air for combustion either just before or progressively during the combustion process. The particles are so fine that they are quickly vaporized by the heat of combustion and if properly mixed with sufficient air will burn with a clean hot flame. There are many ways to atomize oil—under pressure through a small orifice, by compressed air or steam, by centrifugal force from the edge of a rapidly rotating cup or disc and numerous other equally effective methods. Any of the methods used will break the oil into very fine particles and when applied with intelligence will give satisfactory results. With the atomizing type of burner cheaper oils may be utilized; they will start readily from a cold condition and can be applied to installations requiring a high fuel consumption.

The perceptible sound incident to the combustion of oil is dependent largely upon the means employed to mix the oil and air and the rate of B.t.u. liberation per unit of combustion volume. It is obvious that this characteristic can be controlled to some degree by the design of the burner and the method of application to the combustion chamber of the boiler. A further controllable factor is the amount of mechanical sound; this will vary with design, mechanical condition and the adjustment of the unit. The transmission of both mechanical and combustion sounds can be governed to some extent by the utilization of some means to absorb vibration.

IGNITION SYSTEMS

In most natural draft burners the oil is lighted manually with a torch through the fire door, although some of them are provided with a gas, electric or oil pilot, at the option of the owner. Full automatic burners are ignited with either an electric spark from a high tension transformer or from a gas pilot light. This gas pilot, in some designs, burns constantly while in others a combination of the electric and the gas system is used, the spark igniting the gas and the gas flame igniting the oil. The type of ignition system used is dependent to some extent upon the design of the burner and upon the personal opinion of the designer. Several burners are being designed so as to make the means for ignition optional with the purchaser. Where gas is used the application of the

burner may be limited to a territory having a gas supply although it can be used with gas supplied in containers. Under average conditions the cost of ignition with gas is slightly greater than with electricity.

AUTOMATIC BURNER CONTROLS

There are two systems of control instruments. The low voltage (15–20 volts) and the high voltage (110 or 220 volts). Both systems are used with complete satisfaction.

A room thermostat is used to indicate the temperature of the room and to control the operation of the burner so as to maintain the desired temperature between limits of plus or minus 2 deg. This instrument is mechanically accurate and will function according to the temperature conditions of its location. Therefore, it should be located with care. Most people prefer to have it located in the living-room. It should be on an inside wall about 5 ft. from the floor at the breathing level, protected from abnormal drafts such as stairways, or entrances; it should not be placed near chimney, radiators, registers, hot-water or steam pipes or other sources of heat. Special care should be taken to avoid concealed steam or hot-water pipes. Another important factor in maintaining a satisfactory uniform heating throughout the house, which cannot be controlled by the thermostat is the matter of installed radiation. It is important that the radiation be carefully proportioned so that when the desired temperature is reached in the room where the thermostat is located the same temperature will have been reached in all of the rooms of the house.

Apparatus is also usually provided to control the operation of the burner so as to prevent overheating of the boiler or furnace; in case of a steam boiler to prevent the development of abnormal pressures, and in case of a hot-water boiler to prevent too high a water temperature.

Control devices are sometimes added for keeping the temperature of the water in steam boiler below the boiling point during the Summer, so that the same boiler may be used for continuing the domestic hot-water service throughout the Summer without sending steam to the heating system. Such a device is, of course, switched off in the Winter. A safety control is provided to establish a time limit within which the oil must be ignited every time the burner is started and to shut the burner down if for any reason the ignition does not take place or if there is a cessation of combustion. Nearly all of the burners use standard control instruments which in some cases are modified to meet some peculiarity of the design. The majority of the burners operate on the intermittent system, but there are a few that operate on a system known as the high-low, where the burner is continuously operating, the flame intensity being varied to meet the temperature variation as indicated by the thermostat. There is considerable discussion among designing engineers as to the relative merits of the two systems but as the high-low may have a slight advantage during the coldest weather, the intermittent burner will be more economical during the milder weather, so that over the entire heating season, the total amount of fuel used will be very nearly the same.