

With the *expanding gas pilot* system, the pilot is small during the off period of the burner and is automatically increased when the burner is started. After allowing a sufficient time for ignition, it is then automatically decreased again. The valve controlling the size of the pilot flame is actuated by means of a solenoid or a small motor.

Continuous Electric Spark Ignition: By means of a transformer the line voltage is stepped up to many thousand volts, causing a spark to jump between two electrodes placed so as to ignite the atomized oil. This spark continues as long as the burner is in operation.

With the *intermittent spark* system, the spark continues only long enough to ignite the oil. In some burners, the electrodes are then automatically removed from the zone of the atomized oil.

With the *combination electric spark and gas* system, the electric spark ignites the gas pilot, which in turn ignites the oil.

Temperature Control

There are two methods of maintaining the desired temperature—by thermostat and by boiler control.

When thermostatic control is used, 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 come from 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 temperature throughout the house, and one which cannot be controlled by the thermostat is the matter of distribution of the heat within the various rooms. It is important that the distribution be 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.

When the *boiler control* system is used, the pressure in the boiler operates against the diaphragm or bourdon tube and opens or closes the burner circuit by means of a platinum-point or mercury tube switch. Diaphragms or tubes of varying sensitivity may be selected to accommodate wider ranges of pressure, and the starting and stopping limits may be adjusted to meet different weather conditions. Of necessity, this type of control is only semi-automatic, but in large buildings, where it is impossible to locate a thermostat which would control properly the temperatures of many rooms, occupied by many different tenants, this method of control must be used if automatic operation is desired.

Due to the fact that hot water and warm air heat are used mostly in smaller residences, thermostatic control is effective and control of temperature at the hot water boiler furnace casing is seldom employed. (For a further discussion of this subject, see Chapter 17, Automatic Heat Control).

Safety Controls

Apparatus is usually provided to control the operation of the burner to prevent overheating of the boiler or furnace. In the case of a steam boiler, such a device prevents the development of abnormal pressures; in the case of a hot water boiler, it prevents too high a water temperature; and in the case of a warm air furnace, it prevents too high a temperature in the warm air chamber.

A safety control is also 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. The most important safety devices used for this purpose are as follows:

1. *Stack Safety:* This device consists of a spiral bi-metallic coil, similar to the warm-air limit control actuating one or two mercury tube switches depending on the type of circuit used, and serves to maintain the control motor or relay device in the burner on position providing the heat of the products of combustion causes it to reach a certain temperature within a certain specified length of time, 20 seconds or so.

Should the oil fail to ignite, the stack will remain cold, and at the expiration of the allotted time, the burner will be shut off. The accumulation of soot on the bi-metallic spiral affects the operation of this type of switch, and for this reason, some burners force air through a tube passed through the combustion chamber, the stack safety being actuated by the air blown through this tube.

2. *Radiant Heat Safety:* In this device the radiant heat of the flame takes the place of the heat of the products of combustion to actuate the shut-off device. In one type a black surface absorbs the radiant heat causing it to expand and so shut down the burner. In another type, two bulbs are filled with a gas and connected by a tube at the bottom. One bulb is clear and one is black. The radiant heat of the flame causes the gas to expand in the black bulb forcing a quantity of mercury in the connection tube up into the clear bulb making the necessary electric contacts.

With intermittent operation, all the methods of temperature control using thermostats, boiler controls, electric safety devices, expanding gas pilots, etc., are used. Where certain steps must be followed each time there is a call for heat, an accurate timing device is necessary to insure the proper sequence of steps and the correct time intervals. This timing device consists either of a small induction motor which actuates the various gas and oil valves and electric switches, or of a system of relays and electric contacts opened and closed by magnets or electrically heated by-metallic strips.

3. In the absence of an electric safety device, some burners use a *shut off* in the form of a valve which stops the supply of oil to the burner, or a switch which breaks the burner motor circuit. In the event of a flame failure, a small quantity of oil runs into a bucket which overcomes a counter weight and closes the oil valve or opens the switch. Sometimes the counter weight is pivoted so as to pass dead center and lend its weight to the weight of oil in the bucket serving also to deliver an impact to firmly seat the valve or open the switch.