4*B*. *Pressure atomizing*. Oil under pressure is forced through an orifice.

4*C*. *Steam atomizing*. Describing the method of breaking up the oil by means of steam jet.

DOMESTIC BURNERS

The foregoing classifications are flexible and are used merely as a convenience. Homes are heated successfully with burners of each type except the steam atomizing, and with many modifications of each.

Atomization

The purpose of atomization is greatly to increase the surface area of a given quantity of oil in order to accelerate the change from the liquid state (in which oil cannot burn) to the gaseous or vaporous state, in which state it is one of the elementary fuels, gaseous hydrocarbon. This conversion is largely accomplished through the action of radiant heat energy upon the flying globules of oil, and the tremendously increased surface provided aids gasification. While the average domestic burner may consume two or three gallons of fuel an hour, the larger sizes handle up to 50 gal an hour.

Atomization is commonly accomplished by throwing the oil, in a thin film, from the periphery of a rapidly rotating cup or disc, which may be either vertical or horizontal, or by forcing it through a small orifice. Other methods of atomization are used with equal success, and the method of atomization usually is less of a factor in burner efficiency than that of procuring an intimate mixture of the gas with the necessary air for combustion.

Air for Combustion

Air for combustion usually is supplied by a motor-driven fan, several types being in common use. Electric motors varying from $\frac{1}{20}$ hp to $\frac{1}{8}$ hp are used and are started and stopped by the control mechanism. In most cases, they are direct-coupled to the fan as well as to a gear or lobe pump for drawing the oil from the storage tank, and in some cases, to a pump for forcing the oil through the nozzle.

All of the air required for combustion can be supplied by the blower, or else only the *primary* air can be supplied under pressure and provision made so that the remainder will be drawn into the combustion chamber by the natural draft developed by the chimney or by an injector-like action of the primary air. In any event there should be definite control of the quantity of air as well as of the rate of oil supply. Some method of draft regulation is advisable in order to secure proper air regulation. It is necessary to supply more air than is actually required for complete combustion of the oil, but the amount of excess air should be reduced to the lowest workable minimum. Laboratory tests frequently show 25 per cent to 50 per cent more air than is required for combustion, yet field tests indicate that the average burner operates with from 50 per cent to 125 per cent excess air, with a corresponding reduction in the efficiency of the burner. Many domestic burners are extremes of simplicity, the only moving parts being the motor armature with a shaft and direct-connected fan and pump set.

Ignition

The necessity for certain ignition under adverse conditions, when the line voltage is low or the oil is cold is paramount, and this phase of burner design and operation has been given the closest attention, as faulty ignition is more to be feared than improper operation, once the flame is established.

When a burner is operating intermittently under the control of a thermostat, some positive form of ignition is required to function every time there is a call for heat. There are two sources of heat for this initial ignition, an electric spark or the equivalent and a gas flame. Each has its advantages and many combinations have been developed. In *straight electric* ignition, a small transformer converts the line voltage to about 20,000 volts, or sufficient to jump a short gap, the resulting spark directly initiating combustion. In *straight gas* ignition, a gas pilot, properly located, provides the necessary heat.

The gas pilot either may be fixed so as to flame and burn constantly, or a tiny gas flame can be provided with an electric gas valve arranged to admit considerably more gas during the starting period, thus producing a much larger flame. A combination of electric and gas ignition is so arranged that the spark ignites the gas which in turn ignites the oil, the entire ignition system being operative only for a definite period when the thermostat is calling for the burner to start.

Electric ignition on the early burners was limited to those using the higher grades of fuel, gas being required for the commercial burners. Developments in electric ignition, particularly along the line of heated coils or plates, have made this method of ignition desirable.

Temperature Control

Domestic oil burners are controlled directly from the change in temperature of a designated control room (usually the living room, dining room or hall), and/or by temperature or pressure variations in the boiler. Provision may be made for heating domestic water through exchange heaters attached to the boiler, in which water is maintained at a fixed temperature or steam at a set pressure during the entire year. The flow of water or steam to the radiators is controlled by electrically-operated valves, which remain closed during warm weather and open (through the functioning of the room thermosat) when heat is required in the house. The room thermostat either causes heat to be produced by starting the burner when the room temperature drops to a predetermined point or closes the circuit of the motor operating a valve in the flow line of the heating system, the motor opening the water or steam valve and permitting water or steam immediately to flow to the radiators. When the flow in a water heating system is sluggish, the room thermostat also can start the motor of a circulation pump, thereby decreasing the time required to bring the room temperature up to the desired point.

Oil-burner installations put in only a few years ago were simplified to the extent of having a single control element—the room thermostat—that started and stopped the burner. The modern installation provides, in addition, electrical devices inter-wired with the control system to both insure against malfunctioning and to guard against troubles brought on by the characteristics of the heating plant.