Oil as a liquid is difficult to ignite. But it can be converted to a form that can be ignited easily and produce heat. The two basic methods of preparing oil for combustion, that is, breaking it into small particles which can be mixed with air and burned easily, are atomization and vaporization, as discussed in Lesson 1.

Briefly, atomization consists of mechanically breaking the oil up into small particles and then mixing these particles with the air required for combustion. This method is used in the pressure burner on the left in Figure 3-1.

Vaporization consists of actually evaporating the oil by heating it and then mixing this vapor with air so that it can be ignited. This is shown on the right in Figure 3-1.

**FIGURE 3-1. Two methods of oil combustion**
Vaporization of fuel oil can be very simple, but the size of the device required to supply sufficient heat for normal residential needs is quite large and cumbersome. Consequently, the vaporization method is generally used only when heating requirements are small.

**VAPORIZATION**

In the vaporizing burner shown in Figure 3-2, fuel oil is ignited or vaporized in an open pot. Ignition can be brought about by an electric ignitor or a pilot flame. The oil control valve is either open or shut depending on the room thermostat requirements. When the thermostat is satisfied, the valve will be closed. When the valve is closed with an electric ignition, no oil is admitted. When the oil control valve is opened by the room thermostat calling for heat, full oil flow is allowed.

The heat of the pilot flame starts to vaporize incoming oil. However, the primary air is limited so all vaporized oil does not burn immediately. The oil that does burn heats a heavy cast iron plate or grid located on the bottom of the unit. This plate retains heat and proceeds to heat more oil. This heated mixture begins to rise and the flame rises and grows. It eventually arrives at the second level where enough secondary air is being admitted to assure complete burning. This complete and high fire assures enough heat in the lower section to provide a continual supply of warm vaporized fuel.

**ATOMIZATION**

The most common method of preparing fuel oil for burning is atomization. This means mechanically breaking oil up into small droplets and mixing these droplets with air required for combustion. There are three mechanical methods in general use:

- centrifugal force
- low pressure
- high pressure.

Though all three methods are now in general use for residential work, the high-pressure burner is the most common unit found in homes today. The reasons for its popularity will be discussed in the following paragraphs.
**Centrifugal force method**

The use of centrifugal force in a vertical rotary unit is shown in Figure 3-3. The oil is normally fed into the center of a rapidly rotating cup in a fine film and then flies off the edge in a mist form. As the oil flies out toward the perimeter of the furnace, it mixes with the air that is being brought into the furnace by a centrifugal fan attached to the rotating cup. The oil/air mixture is spun against the interior wall of the furnace where it is ignited, generally by electric sparks. The flame then covers the interior wall of the furnace or heat exchanger. The advantage is that the control of oil and air is quite simple with this unit, but mechanical requirements for the device can get complicated.

This burner can also be built to discharge oil in a vertical plane. It is common in large commercial applications. By preheating the oil before its discharge from the burner, the heavy oils No. 4 through No. 6 can be used, in addition to No. 2 oil. The commercial vertical rotary burner is used widely because of its versatility and adaptability.

The vertical rotary shown in Figure 3-3 is not as widely used in residential applications, because it does not adapt itself to the install and forget philosophy of installation. Some regular maintenance is required. Also, the hearth or burning area within the furnace must be installed correctly. Hurried or improper installation will result in improper performance.

**Low pressure method**

With both the high and low pressure methods of atomizing oil, oil is broken up by pressurizing it and then passing it through a small orifice. This forced ejection through the orifice breaks the oil into small particles. It discharges it in such a way as to mix it thoroughly with air required to burn it. The basic difference between the high and low pressure burner, as the name implies, is the pressure at which the fuel is pushed through the atomizing nozzle. In the low-pressure burner shown in Figure 3-4, oil and primary air are mixed and forced down the nozzle tube under a pressure of between 1 and 15 psig. The oil in the mixture is atomized as it passes through the nozzle. The mixture velocity draws or aspirates...
the secondary air into the mixture, preparing it for complete combustion.

Operation of the low-pressure burner is satisfactory, but each manufacturer uses a different mechanical method of mixing primary and secondary air with the atomized fuel. This requires special service knowledge and techniques with each different burner unit. Simplicity of service is essential in any residential heating system, so the low-pressure burner is not common in this application.

**High pressure method**

The high pressure burner does not use primary and secondary air as such. It is designed to atomize all the fuel oil and mix it with sufficient air for complete burning in one simple mechanical operation.

The fuel oil is forced through the atomizing nozzle at a high pressure of about 100 psig, as shown in Figure 3-5. The velocity of the atomized fuel as it leaves the nozzle is sufficient to create a low pressure area into which the combustion air will flow. In addition, the combustion air is being pushed by a mechanical fan and the vanes create turbulence. All of these items—aspiration by the velocity of oil movement, air pressure, and turbulence—are designed to create complete mixing of the atomized fuel and the combustion air. This air and atomized fuel mixture is then ignited and leaves the end of the burner as a flame.

Virtually all high-pressure burners operate in this manner and almost all use very similar mechanical devices such as pumps and fans to bring this condition about. Most of the burners are similar, so service requirements in terms of knowledge and techniques are held to a minimum. This makes it an ideal unit for residential use. Consequently, virtually all residential burners are of the high-pressure type. These high-pressure burners constitute, by far, the greatest percentage of units in use, they will be the only unit covered in detail in this series.

The high-pressure gun burner, as shown in Figure 3-6, is actually an assembled burner. Though it is efficient and versatile, its most important feature is that almost all parts are standardized. Because
of standardization, the availability of parts for the high-pressure gun burner is not a problem. This standardization also makes this burner very popular with the service engineer. If you can understand and service one of these burners, you can understand and service them all.

Figure 3-7 is a view of several flame retention combustion heads. Figure 3-8 is a view of a modern flame retention burner.

Most of the parts for the high-pressure burner such as pumps, nozzles, transformers, etc., are made by a few well-known manufacturers. As mass produced parts are generally low-cost parts, these burners are also a favorite with furnace manufacturers. For these two reasons—ease of service and low cost—these burners are used extensively in residential and small commercial applications.