chamber design is to provide against flame impingement upon either metallic or firebrick surfaces. Manufacturers of oil burners usually have available detailed plans for adapting their burners to various types of boilers, and such information should be utilized.

Controls for oil burner operation, including devices for the safety and protection of a boiler or furnace, are fully described in Chapter 39.

COMMERCIAL AND INDUSTRIAL OIL BURNERS

Oil burning equipment for commercial and industrial applications is usually designed for burning the lower cost heavy fuel oils such as U. S. Commercial Standard Grades Nos. 4, 5, and 6. The viscosity of these oils is much greater than that of the lighter domestic grades and, therefore, the equipment required for satisfactory storage, pumping, and combustion differs greatly from that used in the typical domestic oil burning system.

Both the initial cost and the operating cost of an oil burning system may be affected materially by the characteristics of the industrial fuel oil to be used. These characteristics should, therefore, be given careful consideration when setting up the specifications of the fuel oil for which the system is to be designed.

Classification of Burners

These burners are usually classified according to the method used for atomizing the oil as (1) horizontal rotary cup atomizing, (2) mechanical pressure atomizing, (3) steam atomizing, and (4) air atomizing.

Horizontal Rotary Cup Burner

In this type of burner, oil is delivered into a horizontal cup that is rotated at high speed. As the thin film of oil is spun from the rim of the cup, it enters a cone of high velocity primary air and very effective atomization is obtained. In most applications secondary air for combustion is supplied by natural draft through checkered openings in the floor of the combustion chamber. In some applications, however, the secondary air is admitted through openings surrounding the burner nozzle and may be supplied by forced draft.

The rotary cup burner has been the most popular type in the capacity range from approximately 25 to 500 boiler horsepower. Its principal advantages are that it is a self-contained integral unit; it is readily adaptable to manual, semi-automatic, or fully-automatic control; and the firing rate may be easily modulated through a wide range while maintaining high combustion efficiencies. These burners are frequently used for firing packaged steam generator units.

Mechanical Pressure Atomizing Burner

In this burner oil is atomized by passing it through a specially designed nozzle under pressures of approximately 100 to 250 psig. The air for combustion may be supplied by either natural or forced draft, and is usually admitted through an air register surrounding the burner nozzle or through checkered openings in the floor of the combustion chamber. This burner is popular for marine service and for large capacity multiple installations. It is not readily adapted to fully automatic operation.

Steam Atomizing Burner

High pressure steam is used in this burner for atomizing the oil. Oil is delivered to the nozzle at pressures ranging from approximately 5 to 50 psig, and steam at approximately 50 to 150 psig is admitted to the nozzle by various methods to assist in the atomization. Combustion air is usually supplied by natural draft through checkered openings in the floor of the combustion chamber or through an air register surrounding the nozzle.

This burner is relatively low in first cost but is not adapted to fully automatic operation or wide variations in firing rate.

Air Atomizing Burner

The air atomizing burner is similar to the steam atomizing type, except that air under pressure instead of steam is used for atomization. The performance characteristics of the two burners are also similar but higher temperature oil is usually required when using air for atomization.

Heating the Oil

Commercial Standard No. 4 fuel oil is intended for use in burners that are not equipped with preheating facilities. Nos. 5 and 6 oils usually require preheating equipment to reduce their viscosity sufficiently for satisfactory pumping and atomization. Some oils in the lower viscosity range of No. 5 specification may at times be handled without preheating, but definite viscosity limitations should be specified if this is attempted. In northern climates, the *pour point* of oil may affect the preheating requirements and should be included in the oil specifications.

The common heat sources employed in the heating of fuel oil are steam, hot water and electricity. Shell and tube type heaters connected to the oil fired boiler are normally used for steam or hot water heating. It is extremely important in many plants to provide oil heating equipment that will readily permit starting the burner after a prolonged shutdown during cold weather. While the initial cost of this heating system may be higher, it is necessary where a plant shutdown may cause the oil in the tank and oil lines to congeal to a point where circulation cannot be re-established unless the oil preheating system is designed for this type of service.

OIL STORAGE TANKS AND PIPING

Storage tanks, also the piping and pumping facilities for delivering the oil from the tank to the burner, are very important considerations in the design of an industrial oil burning system. The construction and location of the tank and oil piping are usually subject to local regulations which should always be consulted, and to the standards of the *National Board of Fire Underwriters*, such as *NFBU* Pamphlet No. 31.

The size of the storage tank is usually based on the rate at which oil is to be consumed, the space available, method of oil delivery (truck or tank car) and the ease with which deliveries can be made under all weather conditions. A minimum capacity of at least the maximum weekly usage is desirable. If deliveries are to be made by tank car, the capacity should not be less than 15,000 gal.

The 275 gal oil storage tank is commonly used for domestic installations.