low temperature is pumped out of the evaporator and used at the point where it is required.

The ejector compresses the vapor which has been flashed into the evaporator, plus any entrained air taken out of the water circulated, to a somewhat higher absolute pressure, and the vapor and air mix with the impelling steam on the discharge side of the jet. The total mixture of entrained air, evaporated water, and impelling steam is discharged into a surface condenser at a pressure which permits the available condensing medium to condense it. The resulting condensate is removed from the condenser by a small pump, from which it can be discharged to the sewer or returned to the system in the form of make-up water, or part of it may be returned to the boiler feed pump.

As the normal temperature of water required for air conditioning purposes is between 40 F and 50 F, with an average temperature of approximately 45 F, this type of water cooling is particularly desirable, as the efficiencies and operating costs compare very favorably with other types of refrigerating equipment, especially in view of the fact that the cooling apparatus is, as a general rule, less expensive to install.

Approximately three times as much condenser water is required for the steam jet cooling system as would be necessary with other types of mechanical refrigeration, but as the system can be designed with a large number of jets, each of which can be cut off as the load falls below maximum, constant refrigerating efficiency is maintained and frictional losses and volumetric inefficiencies are kept at a minimum.

The slight amount of air which may be entrained in the cooled water is removed by a small secondary ejector which raises the pressure sufficiently so that the air can be discharged to the atmosphere. A small secondary condenser, of course, is necessary to condense the steam used in the secondary jet.

Steam jet refrigeration has an advantage where cooling towers are used for supplying the condensing liquid, as there is a great saving in the amount of steam used per ton of refrigeration. As the outdoor weather conditions vary the load on the cooling system, the compression ratio between the condenser and evaporator can be reduced and less propelling steam need be used per ton of refrigeration developed. Roughly, in air conditioning work, mechanical compressors show a falling off of 30 to 40 per cent in the power input when using the most economical arrangement of compressors, as the load varies from 100 per cent to 25 per cent of the rated capacity; whereas with steam jet cooling equipment, the amount of steam required for producing the necessary refrigerating effect falls off in direct proportion to the load on the system. When steam refrigeration is employed with cooling towers, the efficiency increases as the output is reduced.

Compressors and Refrigerants

There are many different types of compressors, a number of refrigerants, different types of evaporators, condensers and arrangements of the cycle, and each type has its particular place and usage.

The generally used compressors are of the following types:

1. Reciprocating compressors.
2. Centrifugal compressors.
3. Rotary compressors.
4. Steam jet compressors.

Over-all efficiency of the compressor in smaller commercial installations is not as important a requirement as that the whole unit require little attention and make a minimum of noise. The noise level when the fan, sprays, and compressor are in full operation should not exceed 25 decibels. High compressor efficiency appears as an important factor only in the larger industrial air conditioning systems.

The refrigerants in most general use in commercial and industrial air conditioning are here listed in the order of their inoffensive odor characteristics:

1. Water vapor.
2. Carbon dioxide.
3. Dichlorodifluoromethane.
4. Dichloromethane, sometimes called methylene chloride.
5. Methyl chloride.
6. Ammonia.
7. Sulphur dioxide.

The various types of compressors bear varied relationships to the refrigerants used in both commercial and industrial air conditioning. *Reciprocating compressors* are generally used for any of the refrigerants listed except water vapor, dichloromethane, or other low pressure refrigerant, and they are used in both commercial and domestic air conditioning systems. They have been developed to a point where their efficiency is high and their operation very satisfactory. Relatively low speed operation makes them desirable for general use in large installations. They are of two types, vertical and horizontal, either single or double acting. The horizontal double-acting compressor is not generally used in air conditioning except when carbon dioxide is used as the refrigerant in the larger industrial systems. Vertical, single-acting, encased crank, reciprocating compressors of the uniflow type with valves in the pistons have proven reliable and are used in capacities from 1 hp to more than 100 hp. Reciprocating compressors can be used with more refrigerants than other types of compression units. For instance, when carbon dioxide is used as the refrigerant, a reciprocating compressor is required because of the extremely high pressures and the relatively high ratio of compression.

The production of refrigeration at temperature levels from 25 F to 55 F for general air conditioning involves special types of refrigerating compressors. Among these are:

1. Centrifugal compressors using a volatile refrigerant.
2. Centrifugal compressors using water as a refrigerant.
3. Steam jet or vacuum systems using water as a refrigerant.
4. Rotary compressors using a volatile refrigerant.

The first two types, *centrifugal compressors*, using dichloromethane or water vapor, can theoretically be used with any of the other refrigerants, but the resulting loss in efficiency with the higher pressure gases limits the centrifugal compressor to the two refrigerants named. At the present time the centrifugal compressors are limited to air conditiong systems of a minimum of 50 tons and more. Centrifugal compressors are usually built in two or more stages where the compression ratio is high, and their