

the absorber. In the rectifier selective condensation occurs, the concentration of the absorbent in the condensate being much greater than its concentration in the entering vapor mixture; rectifier condensate is dripped back to the generator.

Recently, several absorption systems using lithium bromide as the absorbent and water as the refrigerant, have been designed and marketed primarily for air conditioning application. The largest of these³ is constructed in sizes up to 200 tons capacity, and is capable of operating with good efficiency on low pressure steam. Since the absorbent is a solid salt which becomes a liquid in solution, only the refrigerant can be evaporated in the generator. Maximum efficiency is therefore approached. The ratio of refrigerating effect to heat input (the performance ratio or commonly used efficiency measure of absorption machines) ranges as high as 75 percent as compared with 40 to 45 percent for the ordinary ammonia absorption system. It is likely that absorption cycles of this nature will find increasing use in air conditioning applications. Both the refrigerant and the absorbent are non-toxic and non-explosive, the performance ratio does not vary greatly from 20 percent of capacity to full load, and the increased efficiency places operating costs in competition with other forms of cooling sources in some applications.

The total energy requirements of an absorption cycle greatly exceed those of a compression system, but the energy required is of low availability (heat) in contrast with the high availability requirements (shaft work) of the mechanical compressor. Thus, in localities where heat and cooling water are obtainable at low cost, it will be more economical to use a large quantity of inexpensive thermal energy in preference to a much smaller quantity of expensive shaft energy. For most absorption systems the heat required will be from one and one-half to five times as much as the heat extracted in the evaporator; cooling water requirements are proportionally high.

Ice Systems

Cold water systems using ice as the cooling agent have been installed in some theaters, restaurants, funeral homes, churches and other places where short hours of operation and high peaks of cooling demand make this type of system desirable. A comparatively small quantity of ice in the water cooling tank of such a system can release refrigeration at a relatively rapid rate. For instance, neighborhood theaters having a peak demand of 1,200,000 Btu per hr (100 tons refrigeration) have found 8 ton capacity ice bunkers satisfactory.

In operation, the water in the air conditioning system is circulated over ice placed in an insulated box, and is cooled to the 38 or 40 deg range or higher, if desired. This cold water is pumped from the ice bunker to air cooling coils or spray type air washers. The blowers, coils, air washer or air handling sections are the same as those parts in any system employing cold water as a refrigerant.

The ice water cooler or ice bunker is usually built at the installation in a location where it can easily be iced. It can be constructed of any desired material such as concrete, steel, or wood with an adequate amount of insulation to save the ice from one period of use to the next. The basic requirement is that the tank be durable and water-tight.

The temperature of the water is controlled at a predetermined point by a thermostat in the supply line. If the temperature drops too low, a

part of the return water is by-passed directly to the sump and is not cooled over the ice. In the larger systems it is customary to install an overflow control which, as the ice melts, discards the excess water through an economizer coil, the surface of which is large in relation to the flow so that the water is warmed to 60 F or more as it is discharged from the system.

In an attempt to lower initial equipment cost and operating expense, or increase the refrigeration capacity of an existing air conditioning system, storage refrigeration has been utilized in a few applications. Some of the methods which have been adopted include the storage of refrigeration in the form of chilled water, chilled brine, ice on evaporator coils⁴ and the accumulation of thin sheets of ice on copper plates in a steel tank.⁵ If the peak load factor is low as compared with a long period of operation, such as in a restaurant, or if the hours of operation are short but the usage factor high, as in a church, then it is possible to consider storage refrigeration. This method of accumulating refrigeration frequently makes it possible to

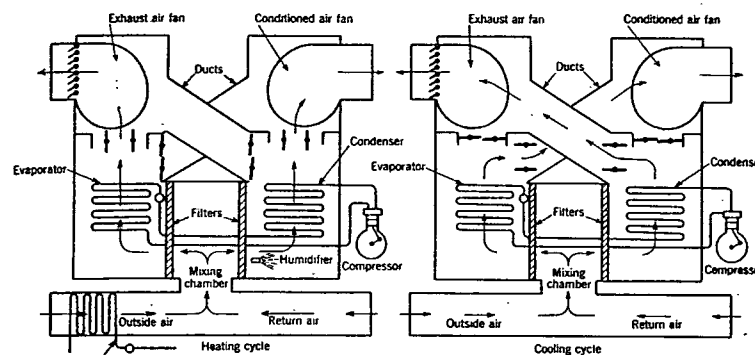


FIG. 7. SCHEMATIC OPERATION OF REVERSED CYCLE CONDITIONING SYSTEM

use low cost off-peak electric power. Power costs may also be reduced by installing a smaller refrigeration plant, augmented by a storage system, and by operating it for longer periods.

The Heat Pump

It has been almost 100 years since Prof. William Thomson (Lord Kelvin) first proposed the use of a compressor as a "warming engine" and as a means of heating buildings to replace equipment for direct burning of fuels. Several early working models were constructed, but the device has remained essentially of laboratory interest until the last 20 years.

Although frequently referred to incorrectly as the reverse cycle system, the heat pump cycle is identical with the ordinary refrigeration cycle, and differs only in the sense that the desired effect is rejection of the heat from the condenser rather than absorption of heat in the evaporator. A discussion of the coefficient of performance for the heat pump is found earlier in this chapter.

The first actual residential heat pump installation was probably made in Scotland in 1927 and since that time, a number of commercial and residential systems have been made in this country. Both progress and growth of interest have been particularly rapid during the past four years and,